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(54) **N-(4-piperidinyl)(dihydrobenzofuran or dihydro-2H-benzopyran)carboxamide derivatives**

N-(4-Piperidinyl)-dihydrobenzofuran- oder -dihydro-2H-benzopyran-carboxamidderivate

Dérivés de la N-(4-pipéridinyl)-dihydrobenzofurane- ou de la dihydro-2H-benzopyrannecarboxamide

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**EP-A- 0 299 566 EP-A- 0 307 172
EP-A- 0 309 043 EP-A- 0 389 037
GB-A- 2 207 673**

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Description

[0001] A number of substituted (3-hydroxy-4-piperidyl)benzamide derivatives have been described as stimulators of the motility of the gastrointestinal system in EP-A-0,076,530; EP-A-0,299,566 and EP-A-0,309,043.

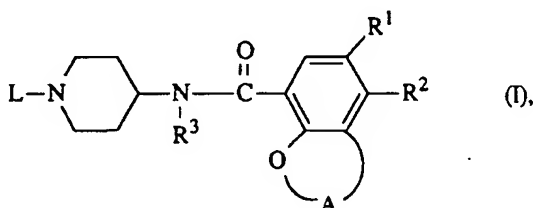
[0002] In EP-A-0,307,172; EP-A-0,124,783; DE-3,702,005; EP-A-0,147,044; EP-A-0,234,872 and US-4,772,459 there are described benzofuran, benzopyran or benzoxepin carboxamide derivatives being substituted on the nitrogen with an alkylamino group or with a mono- or bicyclic hetero ring optionally through an alkyl chain. These compounds are taught to be anti-emetic, anti-psychotic or neuroleptic agents.

[0003] WO-A-84 03 281 describes N-azabicycloalkylbenzamides and -anilides useful as dopamine antagonists, antihypertensives and analgesic potentiators.

[0004] WO-A-88 01 866 describes N-heterocyclylbenzoheterocyclic amides useful as anti-emetic agents especially for administration with cancer chemotherapeutic agents.

[0005] The N-(4-piperidyl)(dihydrobenzofuran or dihydro-2H-benzopyran)carboxamide derivatives of the present invention differ therefrom structurally and pharmacologically by their favourable gastrointestinal motility stimulating properties.

[0006] The present invention is concerned with novel benzamide derivatives having the formula



the N-oxide forms, the salts and the stereochemically isomeric forms thereof, wherein:

A is a radical of formula



wherein one or two hydrogen atoms in said radicals (a-1) to (a-3) may be replaced by a C₁₋₆alkyl radical;

R¹ is hydrogen or halo;

R² is hydrogen, amino, mono or di(C₁₋₆alkyl)amino or C₁₋₆alkylcarbonylamino;

R³ is hydrogen or C₁₋₆alkyl;

L is C₃₋₆cycloalkyl, C₅₋₆cycloalkanone, C₃₋₆alkenyl optionally substituted with aryl, or L is a radical of formula



wherein each Alk is C₁₋₆alkanediyl; and

R⁴ is hydrogen, cyano, C₁₋₆alkylsulfonylamino, C₃₋₆cycloalkyl, C₅₋₆cycloalkanone, aryl, di(aryl)methyl or Het;

R⁵ is hydrogen, C₁₋₆alkyl, hydroxyC₁₋₆alkyl, C₃₋₆cycloalkyl, aryl or Het;

X is O, S, SO₂ or NR⁶; said R⁶ being hydrogen, C₁₋₆alkyl or aryl;

R⁷ is hydrogen, C₁₋₆alkyl, C₃₋₆cycloalkyl, aryl, arylC₁₋₆alkyl, di(aryl)methyl, C₁₋₆alkyloxy or hydroxy;

Y is NR⁸ or a direct bond; said R⁸ being hydrogen, C₁₋₆alkyl or aryl;

R⁹ and R¹⁰ each independently are hydrogen, C₁₋₆alkyl, C₃₋₆cycloalkyl, aryl or arylC₁₋₆alkyl, or R⁹ and R¹⁰ com-

bined with the nitrogen atom bearing R⁹ and R¹⁰ may form a pyrrolidinyl or piperidinyl ring both being optionally substituted with C₁₋₆alkyl, amino or mono or di(C₁₋₆alkyl)amino, or said R⁹ and R¹⁰ combined with the nitrogen bearing R⁹ and R¹⁰ may form a piperazinyl or 4-morpholinyl radical both being optionally substituted with C₁₋₆alkyl; each aryl being unsubstituted phenyl or phenyl substituted with 1,2 or 3 substituents each independently selected from halo, hydroxy, C₁₋₆alkyl, C₁₋₆alkyloxy, aminosulfonyl, C₁₋₆alkylcarbonyl, nitro, trifluoromethyl, amino or amino-carbonyl; and
 each Het being a five- or six-membered heterocyclic ring containing 1,2,3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that no more than 2 oxygen and/or sulfur atoms are present, said five- or six-membered ring being optionally condensed with a five- or six-membered carboxylic or heterocyclic ring also containing 1,2,3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that the latter ring does not contain more than 2 oxygen and/or sulfur atoms and that the total number of heteroatoms in the bicyclic ring system is less than 6; when Het is a monocyclic ring system it may optionally be substituted with up to 4 substituents; when Het is a bicyclic ringsystem it may optionally be substituted with up to 6 substituents; said substituents being selected from the group consisting of halo, hydroxy, cyano, trifluoromethyl, C₁₋₆alkyl, arylC₁₋₆alkyl, aryl, C₁₋₆alkyloxy, C₁₋₆alkyloxyC₁₋₆alkyl, hydroxyC₁₋₆alkyl, C₁₋₆alkylthio, mercapto, nitro, amino, mono and di(C₁₋₆alkyl)amino, arylC₁₋₆alkylamino, aminocarbonyl, mono and di(C₁₋₆alkyl)aminocarbonyl, C₁₋₆alkyloxy carbonyl, arylC₁₋₆alkyloxy carbonyl, a bivalent radical =O and =S; provided that when R⁵ is Het, Het is connected to X on a carbon atom.

[0007] As used in the foregoing definitions halo is generic to fluoro, chloro, bromo and iodo; C₁₋₆alkyl defines straight and branched chain saturated hydrocarbon radicals having from 1 to 6 carbon atoms such as, for example, methyl, ethyl, propyl, butyl, hexyl, 1-methylethyl, 2-methylpropyl and the like; C₃₋₆cycloalkyl defines cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl; C₅₋₆cycloalkanone defines cyclopentanone and cyclohexanone; C₃₋₆alkenyl defines straight and branched chain hydrocarbon radicals containing one double bond and having from 3 to 6 carbon atoms such as, for example, 2-propenyl, 3-butenyl, 2-butenyl, 2-pentenyl, 3-pentenyl, 3-methyl-2-butenyl and the like; and when a C₃₋₆alkenyl is substituted on a heteroatom, then the carbon atom of said C₃₋₆alkenyl connected to said heteroatom preferably is saturated; C₁₋₆alkanediyl defines bivalent straight or branched chain hydrocarbon radicals containing from 1 to 6 carbon atoms such as, for example, 1,2-ethanediyl, 1,3-propanediyl, 1,4-butanediyl, 1,5-pentanediyl, 1,6-hexanediyl and the branched isomers thereof.

[0008] The salts as mentioned hereinabove are meant to comprise the therapeutically active non-toxic addition salt forms which the compounds of formula (I) are able to form. The latter can conveniently be obtained by treating the base form with such appropriate acids as inorganic acids, for example, hydrohalic acids, e.g. hydrochloric, hydrobromic and the like, sulfuric acid, nitric acid, phosphoric acid and the like; or organic acids, for example, acetic, propanoic, hydroxyacetic, 2-hydroxypropanoic, 2-oxopropanoic, ethanedioic, propanedioic, butanedioic, (Z)-2-butenedioic, (E)-2-butenedioic, 2-hydroxybutanedioic, 2,3-dihydroxybutanedioic, 2-hydroxy-1,2,3-propanetricarboxylic, methanesulfonic, ethanesulfonic, benzenesulfonic, 4-methylbenzenesulfonic, cyclohexanesulfamic, 2-hydroxybenzoic, 4-amino-2-hydroxybenzoic and the like acids. Conversely the salt form can be converted by treatment with alkali into the free base form.

[0009] The compounds of formula (I) containing acidic protons may also be converted into their therapeutically active non-toxic metal or amine salt forms by treatment with appropriate organic or inorganic bases.

[0010] The term addition salt also comprises the hydrates and solvent addition forms which the compounds of formula (I) are able to form. Examples of such forms are e.g. hydrates, alcoholates and the like.

[0011] As defined hereinabove, R⁷ may be hydroxy and in that instance Y in radical (b-3) in particular is a direct bond.

[0012] The N-oxides of the compounds of formula (I) are meant to comprise those compounds of formula (I) wherein one or several nitrogen atoms are oxidated to the N-oxide form, in particularly those N-oxides wherein the piperidine-nitrogen is N-oxidated.

[0013] In the compounds of formula (I) wherein R⁴ and R⁵ is Het, said Het may be partly or completely saturated, or unsaturated. The compounds of formula (I) wherein Het is partly saturated or unsaturated and is substituted with hydroxy, mercapto or amino, may also exist in their tautomeric forms. Such forms although not explicitly indicated hereinabove, are intended to be included within the scope of the invention.

[0014] In particular, Het may be :

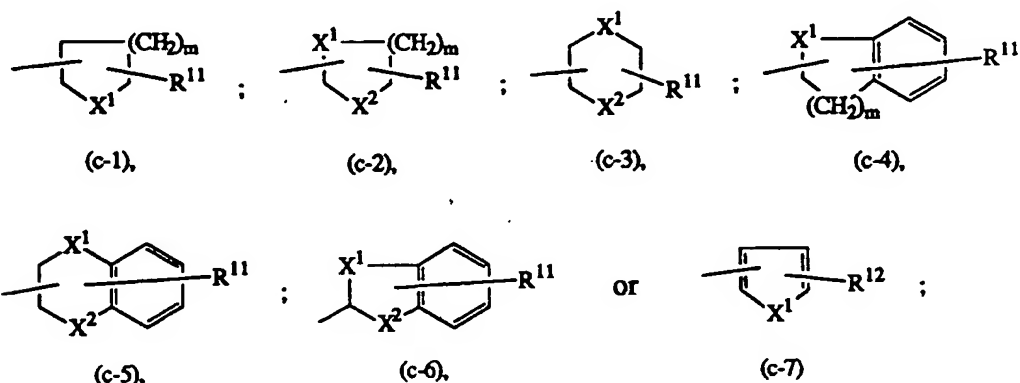
- i) an optionally substituted five- or six-membered heterocyclic ring containing 1, 2, 3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that no more than 2 oxygen and/or sulfur atoms are present; or
- ii) an optionally substituted five- or six-membered heterocyclic ring containing 1, 2 or 3 heteroatoms selected from oxygen, sulfur and nitrogen, being fused with an optionally substituted five- or six-membered ring through 2 carbon atoms or 1 carbon and 1 nitrogen atom, containing in the remainder of the fused ring only carbon atoms; or

iii) an optionally substituted five- or six-membered heterocyclic ring containing 1, 2 or 3 heteroatoms selected from oxygen, sulfur and nitrogen, being fused with an optionally substituted five- or six-membered heterocyclic ring through 2 carbon atoms or 1 carbon and 1 nitrogen atom, containing in the remainder of the fused ring 1 or 2 heteroatoms selected from oxygen, sulfur and nitrogen;

wherein Het being a monocyclic ring system may be optionally substituted with up to 4 substituents; and wherein Het being a bicyclic ring system may be optionally substituted with up to 6 substituents, said substituents being the same as defined hereinabove.

[0015] A more particular subgroup of Het comprises cyclic ether or thioether ring systems containing one or two oxygen and/or sulfur atoms, provided that when two oxygen and/or sulfur atoms are present, they are in non-adjacent positions in the ring. Said cyclic ether or thioether ring systems are optionally condensed with a five- or six-membered carbocyclic ring. These cyclic ether or thioether ring systems may also be substituted with one or more C₁₋₆alkyl, C₁₋₆alkyloxy, C₁₋₆alkyloxyC₁₋₆alkyl or hydroxyC₁₋₆alkyl substituents. This subgroup of Het radicals will be represented by the symbol Het¹.

[0016] Typical cyclic ethers and thioethers which are covered by R⁴ being Het in the compounds of the present invention can be represented by the following formulae:



wherein

each X¹ and X² independently are O or S;

m is 1 or 2;

each R¹¹ is hydrogen, C₁₋₄alkyl, C₁₋₄alkyloxyC₁₋₄alkyl or hydroxyC₁₋₄alkyl and

R¹² is hydrogen, halo or C₁₋₄alkyl.

[0017] Further particular cyclic ethers are selected from the group consisting of 1,3-dioxolanyl optionally substituted with C₁₋₄alkyl; 1,3-dioxanyl optionally substituted with C₁₋₄alkyl; tetrahydrofuranyl optionally substituted with C₁₋₄alkyl; tetrahydropyranyl optionally substituted with C₁₋₄alkyl; 2,3-dihydro-1,4-benzodioxinyl; 2,3-dihydrobenzofuran and 3,4-dihydro-1(2H)-benzopyran, with tetrahydrofuranyl being preferred.

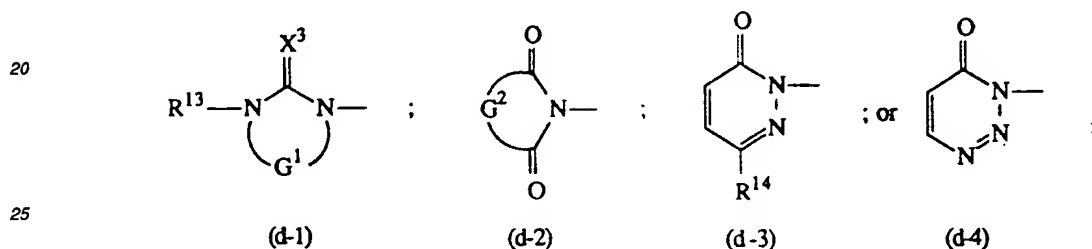
[0018] Another more particular subgroup of Het comprises heterocyclic ring systems which are selected from the group consisting of pyrrolidinyl; piperidinyl; pyridinyl which is optionally substituted with one or two substituents each independently selected from halo, hydroxy, cyano, C₁₋₆alkyl, trifluoromethyl, C₁₋₆alkyloxy, aminocarbonyl, mono and di(C₁₋₆alkyl)aminocarbonyl, amino, mono and di(C₁₋₆alkyl)amino and C₁₋₆alkyloxycarbonyl; pyrimidinyl which is optionally substituted with one or two substituents each independently selected from halo, hydroxy, cyano, C₁₋₆alkyl, C₁₋₆alkyloxy, amino and mono and di(C₁₋₆alkyl)amino; pyridazinyl which is optionally substituted with C₁₋₆alkyl or halo; pyrazinyl which is optionally substituted with one or two substituents each independently selected from halo, hydroxy, cyano, C₁₋₆alkyl, C₁₋₆alkyloxy, amino, mono- and di(C₁₋₆alkyl)amino and C₁₋₆alkyloxycarbonyl; pyrrolyl which is optionally substituted with C₁₋₆alkyl; pyrazolyl which is optionally substituted with C₁₋₆alkyl; imidazolyl which is optionally substituted with C₁₋₆alkyl; triazolyl which is optionally substituted with C₁₋₆alkyl; quinolinyl optionally substituted with up to two substituents each independently selected from halo, hydroxy, cyano, C₁₋₆alkyl, C₁₋₆alkyloxy, amino, mono and di(C₁₋₆alkyl)amino and trifluoromethyl; isoquinolinyl optionally substituted with up to two substituents each independently selected from halo, hydroxy, cyano, C₁₋₆alkyl, C₁₋₆alkyloxy, amino, mono and di(C₁₋₆alkyl)amino and trifluoromethyl; quinoxalinyl optionally substituted with up to two substituents each independently selected from C₁₋₆alkyl, hydroxy, halo, cyano and C₁₋₆alkyloxy; quinazolinyl optionally substituted with C₁₋₆alkyl; benzimidazolyl optionally substituted

with C₁₋₆alkyl; indolyl optionally substituted with C₁₋₆alkyl; 5,6,7,8-tetrahydroquinoliny optionally substituted with up to two substituents each independently selected from halo, hydroxy, cyano, C₁₋₆alkyl, C₁₋₆alkoxy, amino, mono- and di(C₁₋₆alkyl)amino and trifluoromethyl; 5,6,7,8-tetrahydroquinoxaliny optionally substituted with up to two substituents each independently selected from C₁₋₆alkyl, hydroxy, halo, cyano and C₁₋₆alkoxy; thiazolyl optionally substituted with C₁₋₆alkyl; oxazolyl optionally substituted with C₁₋₆alkyl; benzoxazolyl optionally substituted with C₁₋₆alkyl; benzothiazolyl optionally substituted with C₁₋₆alkyl. This subgroup of Het radicals will be represented by the symbol Het².

[0019] Further particular heterocyclic ring systems within this subgroup are for example, piperidiny, pyridiny optionally substituted with up to two substituents selected from C₁₋₄alkyl, cyano, halo and trifluoromethyl; pyrazinyl optionally substituted with cyano, halo, C₁₋₄alkyloxycarbonyl and C₁₋₄alkyl; and pyridazinyl optionally substituted with halo.

[0020] Another more particular subgroup of Het comprises optionally substituted five- or six-membered cyclic amides containing one, two or three nitrogen atoms, said five or six-membered heterocyclic ring being optionally condensed with a five- or six-membered carbocyclic or heterocyclic ring containing one or two nitrogen atoms or one sulfur or oxygen atom. This subgroup of Het will be represented hereinafter by the symbol Het³.

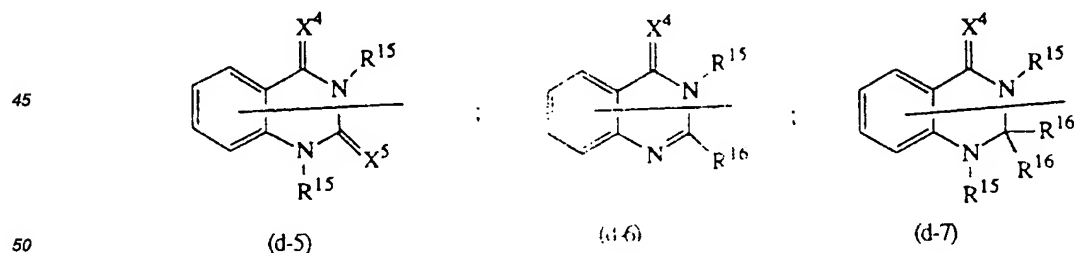
[0021] Typical monocyclic amides covered by R⁴ and R⁵ being Het in the compounds of the present invention, can be represented by the following formulae:

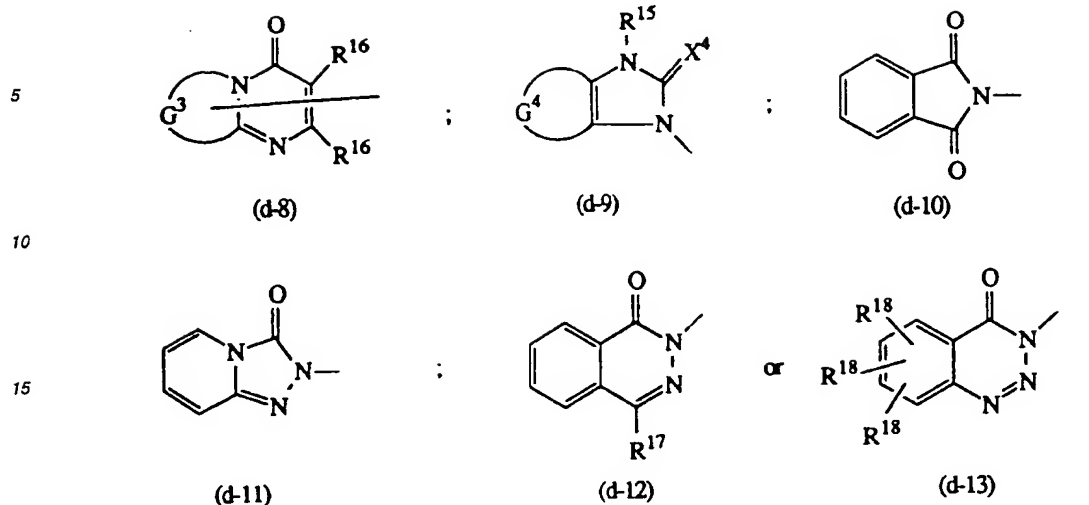


wherein

30 X³ is O or S;
 R¹³ is hydrogen, C₁₋₆alkyl or arylC₁₋₆alkyl;
 R¹⁴ is hydrogen, halo, C₁₋₆alkyl or aryl;
 G¹ is -CH₂-CH₂-, -CH=CH-, -N=N-, -C(=O)-CH₂- or -CH₂-CH₂-CH₂-,
 35 wherein one or two hydrogen atoms each independently may be replaced by C₁₋₆alkyl; and
 G² is -CH₂-CH₂-, -CH₂-N(R¹³)- or -CH₂-CH₂-CH₂-, wherein one or two hydrogen atoms each independently may be replaced by C₁₋₆alkyl.

[0022] Typical bicyclic amides covered by the definition of R⁴ and R⁵ being Het, can be represented by the following formulae:





wherein X^4 and X^5 and each independently are O or S;

each R^{15} independently is hydrogen, C_{1-6} alkyl or aryl C_{1-6} alkyl;

each R^{16} independently is hydrogen, halo, C_{1-6} alkyl or C_{1-6} alkyloxy;

R^{17} is hydrogen, halo, C_{1-6} alkyl or aryl; and

each R^{18} independently is hydrogen, C_{1-6} alkyloxy or C_{1-6} alkyl

wherein the radicals (d-5), (d-6), (d-7) and (d-8) may be connected to respectively Alk or X by replacing either a hydrogen or a radical R^{15} and R^{16} by a free bond;

G^3 is $-\text{CH}=\text{CH}-\text{CH}=\text{CH}-$, $-(\text{CH}_2)_4-$, $-\text{S}-(\text{CH}_2)_2-$, $-\text{S}-(\text{CH}_2)_3-$, $-\text{S}-\text{CH}=\text{CH}-$, $-\text{CH}=\text{CH}-\text{O}-$, $-\text{NH}-(\text{CH}_2)_2-$, $-\text{NH}-(\text{CH}_2)_3-$, $-\text{NH}-\text{CH}=\text{CH}-$, $-\text{NH}-\text{N}=\text{CH}-\text{CH}_2-$, $-\text{NH}-\text{CH}=\text{N}-$ or $-\text{NH}-\text{N}=\text{CH}-$;

G^4 is $-\text{CH}=\text{CH}-\text{CH}=\text{CH}-$, $-\text{CH}=\text{CCl}-\text{CH}=\text{CH}-$, $\text{CCl}=\text{CH}-\text{CH}=\text{CH}-$, $-\text{N}=\text{CH}-\text{CH}=\text{CH}-$, $-\text{CH}=\text{N}-\text{CH}=\text{CH}-$, $-\text{CH}=\text{CH}-\text{N}=\text{CH}-$, $-\text{CH}=\text{CH}-\text{CH}=\text{N}-$, $-\text{N}-\text{CH}=\text{N}=\text{CH}-$ or $-\text{CH}=\text{N}-\text{CH}=\text{N}-$.

[0023] Further particular heterocyclic ring systems within this subgroup are selected from the group consisting of 2,3-dihydro-2-oxo-1H-benzimidazolyl optionally substituted with C_{1-6} alkyl; 2-oxo-1-imidazolidinyl optionally substituted with C_{1-4} alkyl; 2,5-dioxo-1-imidazolidinyl optionally substituted with C_{1-4} alkyl; 3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-yl optionally substituted with 1, 2 or 3 C_{1-4} alkyloxy groups; 1-oxo-2(1H)-phthalazinyl; 2,3-dihydro-5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl optionally substituted with C_{1-4} alkyl; 5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl optionally substituted with C_{1-4} alkyl; 1,6-dihydro-6-oxo-1-pyridazinyl optionally substituted with C_{1-4} alkyl or halo; and 1,2,3,4-tetrahydro-2,4-dioxo-3-quinazolinyl.

[0024] Interesting compounds within the invention are those compounds of formula (I) wherein R^1 is hydrogen or halo; and/or R^2 is hydrogen, amino or C_{1-6} alkylamino; and/or R^3 is hydrogen.

[0025] Other interesting compounds within the invention are those compounds of formula (I) wherein R^1 is hydrogen or halo; and/or R^2 is hydrogen, amino or C_{1-6} alkylamino; and/or R^3 is C_{1-4} alkyl.

[0026] More interesting compounds are those interesting compounds wherein

L is C_{3-6} cycloalkyl or C_{3-6} alkenyl optionally substituted with aryl; or

L is a radical of formula (b-1) wherein R^4 is hydrogen, cyano, C_{3-6} cycloalkyl, C_{5-6} cycloalkanone, aryl, di(aryl)methyl or Het; or

L is a radical of formula (b-2) wherein X is O, S or NH and R^5 is hydrogen, C_{1-4} alkyl, C_{3-6} cycloalkyl, aryl or Het; or L is a radical of formula (b-3) where in Y is NR^8 or a direct bond, R^8 is hydrogen or aryl and R^7 is hydrogen, C_{1-4} alkyl, aryl, C_{1-4} alkyloxy or hydroxy; or

L is a radical of formula (b-4) wherein Y is NH or a direct bond and R^9 and R^{10} each independently are hydrogen or C_{1-4} alkyl, or R^9 and R^{10} combined with the nitrogen bearing said R^9 and R^{10} may form a pyrrolidinyl or piperidinyl radical.

[0027] Most interesting compounds are those more interesting compounds wherein A is a radical of formula (a-1)

or (a-2) wherein the carbon atom adjacent to the oxygen atom is optionally substituted with one or two C₁₋₄alkyl substituents.

[0028] Preferred compounds are those most interesting compounds wherein

- 5 L is C₅₋₆cycloalkyl or C₃₋₆alkenyl optionally substituted with aryl; or
 L is a radical of formula (b-1) wherein Alk is C₁₋₄alkanediyl and R⁴ is cyano, C₃₋₆cycloalkyl, diarylmethyl or Het; or
 L is a radical of formula (b-2) wherein Alk is C₁₋₄alkanediyl, X is O or NH and R⁵ is hydrogen, C₁₋₄alkyl, C₃₋₆cycloalkyl, aryl or Het; or
 10 L is a radical of formula (b-3) wherein Alk is C₁₋₄alkanediyl, Y is NH or a direct bond and R⁷ is C₁₋₄alkyl, aryl, C₁₋₄alkyloxy or hydroxy.

[0029] More preferred compounds are those preferred compounds wherein

- 15 Het is pyrrolidinyl; piperidinyl; pyridinyl optionally substituted with C₁₋₆alkyl or cyano; pyrazinyl optionally substituted with C₁₋₆alkyl; benzimidazolyl optionally substituted with C₁₋₆alkyl; or indolyl optionally substituted with C₁₋₆alkyl; or
 Het is a radical of formula (c-1), (c-2) or (c-4); or
 Het is a radical of formula (d-1), (d-3), (d-5), (d-8), (d-9), (d-12) or (d-13).

- [0030] Particular preferred compounds are those more preferred compounds wherein Het is tetrahydrofuranyl optionally substituted with C₁₋₄alkyl; 1,3-dioxolanyl optionally substituted with C₁₋₄alkyl; 3,4-dihydro-1(2H)-benzopyran-2-yl; pyrrolidinyl; piperidinyl; pyridinyl optionally substituted with cyano; pyrazinyl optionally substituted with C₁₋₄alkyl; benzimidazolyl; indolyl; 2,3-dihydro-2-oxo-1H-benzimidazolyl optionally substituted with C₁₋₄alkyl; 2-oxo-1-imidazolidinyl optionally substituted with C₁₋₄alkyl; 3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-yl optionally substituted with three C₁₋₄alkyloxy groups; 1-oxo-2(1H)-phthalazinyl; 2,3-dihydro-5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl optionally substituted with C₁₋₄alkyl; 5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl optionally substituted with C₁₋₄alkyl; 1,6-dihydro-6-oxo-1-pyridazinyl optionally substituted with C₁₋₄alkyl or halo; and 1,2,3,4-tetrahydro-2,4-dioxo-3-quinazolinyl.

- [0031] More particular preferred compounds are those preferred compounds wherein R¹ is hydrogen or chloro; and/or R² is hydrogen, amino or (1-methylethyl)amino; and/or R³ is hydrogen; and/or L is a radical of formula (b-1) wherein R⁴ is cyano, cyclopentyl, tetrahydrofuranyl, piperidinyl, 7-methyl-5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl; 3-ethyl-2,3-dihydro-2-oxo-1H-benzimidazolyl; 1,6-dihydro-3-methyl-6-oxo-1-pyridazinyl; or

L is a radical of formula (b-2) where in X is O or NH and R⁵ is H or 4-fluorophenyl; or

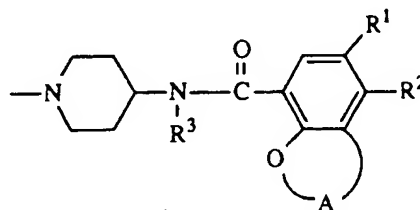
L is a radical of formula (b-3) where in Y is NH or a direct bond and R⁷ is methyl, ethoxy or 3,4,5-trimethoxyphenyl.

- 35 [0032] At present, the most preferred compounds of formula (I) are 5-amino-6-chloro-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carboxamide;

(-)-(R)-5-amino-6-chloro-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carboxamide; and

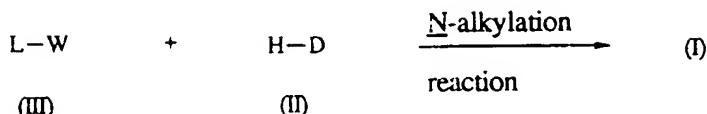
- 40 (-)-(R)-4-amino-5-chloro-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarboxamide.

[0033] In order to simplify the structural representations of the compounds of formula (I) and of certain starting materials and intermediates thereof, the radical



- 55 will hereafter be represented by the symbol D.

[0034] The compounds of formula (I) can be prepared by N-alkylating a piperidine of formula (II) with an intermediate of formula (III).



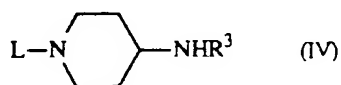
[0035] W as described in the reaction of (III) with (II) and in the following reaction schemes is an appropriate leaving group such as, for example, halo, preferably, chloro, bromo or iodo, or a sulfonyloxy group, e.g. methanesulfonyloxy, 4-methylbenzenesulfonyloxy and the like leaving groups.

[0036] The N-alkylation reaction of (II) with (III) is conveniently conducted in a reaction-inert solvent such as, for example, water; an aromatic hydrocarbon, e.g. benzene, methylbenzene, dimethylbenzene, chlorobenzene, methoxybenzene and the like; an alkanol, e.g. methanol, ethanol, 1-butanol and the like; a halogenated hydrocarbon, e.g. dichloromethane, trichloromethane and the like; an ester, e.g. ethyl acetate, γ -butyrolactone and the like; a ketone, e.g. 2-propanone, 4-methyl-2-pentanone and the like; an ether, e.g. 1,4-dioxane, 1,1'-oxybisethane, tetrahydrofuran and the like; a polar aprotic solvent, e.g. N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, hexamethylphosphoric triamide, 1,3-dimethyl-3,4,5,6-tetrahydro-2(1H)-pyrimidinone, 1,3-dimethyl-2-imidazolidinone, 1,1,3,3-tetramethylurea, nitrobenzene, 1-methyl-2-pyrrolidinone and the like, or a mixture of such solvents.

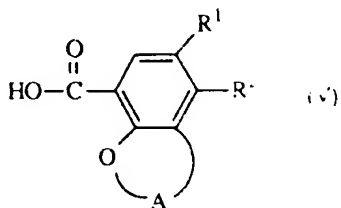
[0037] The addition of an appropriate base such as, for example, an alkali or an earth alkaline metal carbonate, hydrogen carbonate, carboxylate, amide, oxide, hydroxide or alkoxide, e.g. sodium carbonate, sodium hydrogen carbonate, potassium carbonate, calcium oxide, sodium acetate, sodium amide, sodium hydroxide, sodium methoxide and the like or an organic base such as, for example, an amine, e.g. N,N-dimethyl-4-pyridinamine, N,N-diethylethanamine, N-(1-methylethyl)-2-propanamine, 1,4-diazabicyclo[2,2,2]octane, 4-ethylmorpholine and the like, may be utilized to pick up the acid which is liberated during the course of the reaction. In some instances the addition of a iodide salt, preferably an alkali metal iodide, or a crown ether, e.g. 1,4,7,10,13,16-hexaoxacyclooctadecane and the like, may be appropriate. Stirring and somewhat elevated temperatures may enhance the rate of the reaction. Additionally, it may be advantageous to conduct said N-alkylation under an inert atmosphere such as, for example, oxygen-free argon or nitrogen gas. Alternatively, said N-alkylation may be carried out by applying art-known conditions of phase transfer catalysis reactions. Said conditions comprise stirring the reactants, with an appropriate base and optionally under an inert atmosphere as defined hereinabove, in the presence of a suitable phase transfer catalyst such as, for example, a trialkylphenylmethylammonium, tetraalkylammonium, tetraalkylphosphonium, tetraarylphosphonium halide, hydroxide, hydrogen sulfate and the like catalysts. Somewhat elevated temperatures may be appropriate to enhance the rate of the reaction.

[0038] In this and the following preparations, the reaction products may be isolated from the reaction mixture and, if necessary, further purified according methodologies generally known in the art such as, for example, extraction, distillation, crystallization, trituration and chromatography.

[0039] The compounds of formula (I) can also be prepared by the amidation reaction of an amine of formula



with a carboxylic acid of formula

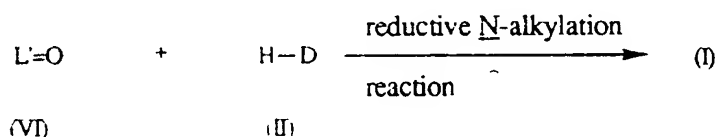


or a functional derivative thereof, such as a halide, a symmetrical or mixed anhydride or an ester, preferably an activated ester. Said functional derivative may be generated in situ, or if desired, be isolated and further purified before reacting it with the amine of formula (IV). Functional derivatives may be prepared following art-known procedures, for example,

by reacting the carboxylic acid of formula (V) with thionyl chloride, phosphorous trichloride, phosphoryl chloride and the like, or by reacting the carboxylic acid of formula (V) with an acyl halide, e.g. acetyl chloride, ethyl carbonochloridate and the like. Or the intermediates (IV) and (V) may be coupled in the presence of a suitable reagent capable of forming amides, e.g. dicyclohexylcarbodiimide, 2-chloro-1-methylpyridinium iodide and the like.

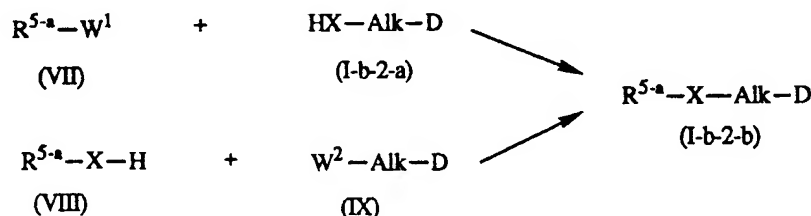
[0040] Said amidation reactions may conveniently be carried out by stirring the reactants in a suitable reaction-inert solvent such as, for example, a halogenated hydrocarbon, e.g. dichloromethane, trichloromethane and the like, an aromatic hydrocarbon, e.g. methylbenzene and the like, an ether, e.g. 1,1'-oxybisethane, tetrahydrofuran and the like or a dipolar aprotic solvent, e.g. *N,N*-dimethylformamide, *N,N*-dimethylacetamide and the like. The addition of a suitable base may be appropriate, in particular a tertiary amine such as, *N,N*-diethylethanamine. The water, the alcohol or the acid which is liberated during the course of the reaction may be removed from the reaction mixture according to methodologies generally known in the art such as, for example, azeotropical distillation, complexation or salt formation. Further it may be expedient to protect amino or hydroxy groups during the course of the reaction to avoid undesired side reactions. Suitable protecting groups comprise readily removable groups such as, C_{1-6} alkylcarbonyl, C_{1-4} alkyloxycarbonyl, arylmethyl, tertiary butyl and the like protective groups.

[0041] The compounds of formula (I) can alternatively be prepared by the reductive *N*-alkylation reaction of an appropriate ketone or aldehyde of formula $L'=O$ (VI), said $L'=O$ being a compound of formula $L-H$ wherein two geminal hydrogen atoms in the C_{1-6} alkanediyl or C_{3-6} cycloalkanediyl moiety are replaced by $=O$, with a piperidine of formula $H-D$ (II).



[0042] Said reductive *N*-alkylation reaction may conveniently be carried out by reducing a mixture of the reactants in a suitable reaction-inert solvent. In particular, the reaction mixture may be stirred and/or heated in order to enhance the reaction rate. Suitable solvents are, for example, water, C_{1-6} alkanols, e.g. methanol, ethanol, 2-propanol and the like; esters, e.g. ethylacetate, γ -butyrolactone and the like; ethers, e.g. 1,4-dioxane, tetrahydrofuran, 1,1'-oxybisethane, 2-methoxyethanol and the like; dipolar aprotic solvents, e.g. *N,N*-dimethylformamide, dimethyl sulfoxide and the like; carboxylic acids, e.g. acetic acid, propanoic acid and the like; or a mixture of such solvents. The term "art-known reductive *N*-alkylation procedures" means that the reaction is carried out either with sodium cyanoborohydride, sodium borohydride, formic acid or a salt thereof, e.g. ammonium formate and the like reducing agents, or alternatively under hydrogen atmosphere, optionally at an increased temperature and/or pressure, in the presence of an appropriate catalyst such as, for example, palladium-on-charcoal, platinum-on-charcoal and the like. In order to prevent the undesired further hydrogenation of certain functional groups in the reactants and the reaction products, it may be advantageous to add an appropriate catalyst-poison to the reaction mixture, e.g., thiophene, quinoline, sulphur and the like. In some instances it may also be advantageous to add an alkali metal salt to the reaction mixture such as, for example, potassium fluoride, potassium acetate and the like salts.

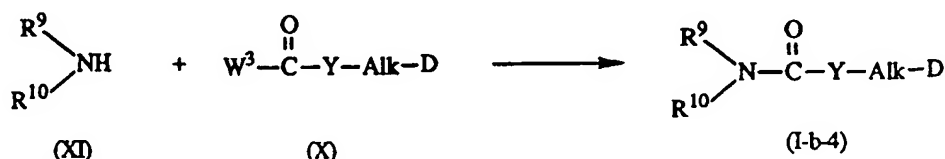
[0043] The compounds of formula (I) wherein L is a radical of formula (b-2) and R^5 is aryl or Het, said R^5 being represented by R^{5-a} , can alternatively be prepared according to one of the following alkylation procedures.



[0044] In (VII) and (IX) W^1 and W^2 are appropriate leaving groups such as, for example, halo, e.g. chloro or bromo, C_{1-6} alkyloxy or C_{1-6} alkylthio, e.g. methoxy or methylthio. W^2 can also be a sulfonyloxy group or pyridinium group.

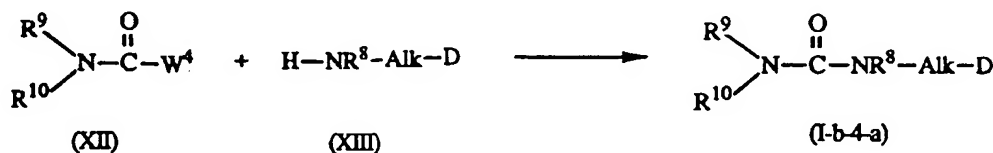
[0045] The alkylation reactions of (VII) with (I-b-2-a) and (VIII) with (IX) can be carried out according to art-known procedures, e.g. by stirring the reactants without a solvent or in an inert organic solvent such as, for example, an aromatic hydrocarbon, e.g. benzene, methylbenzene, dimethylbenzene, and the like, a lower alkanol, e.g. methanol, ethanol, 1-butanol and the like, a ketone, e.g. 2-propanone, 4-methyl-2-pentanone and the like, an ether, e.g. 1,4-dioxane, 1,1'-oxybisethane, tetrahydrofuran and the like, a polar aprotic solvent, e.g. *N,N*-dimethylformamide, *N,N*-dimethylacetamide, dimethylsulfoxide, nitrobenzene, 1-methyl-2-pyrrolidinone and the like or a mixture of two or more of such solvents. The addition of an appropriate base such as, for example, an alkali or an earth alkaline metal carbonate, hydrogen carbonate, hydroxide, alkoxide, hydride, amide or oxide, e.g. sodium carbonate, sodium hydrogen carbonate, potassium carbonate, sodium hydroxide, sodium methoxide, sodium hydride, sodium amide, calcium carbonate, calcium hydroxide, calcium oxide and the like or an organic base, such as, for example, a tertiary amine, e.g. *N,N*-diethylethanamine, *N*-(1-methylethyl)-2-propanamine, 4-ethylmorpholine and the like, may be utilized to pick up the acid which is liberated during the course of the reaction. In some instances the addition of a iodide salt, preferably an alkali metal iodide or a crown ether, e.g. 1,4,7,10,13,16-hexaoxacyclooctadecane and the like, may be appropriate.

[0046] The compounds of formula (I) wherein L is a radical of formula (b-4), said compounds being represented by (I-b-4), can also be prepared by reacting a piperidine of formula (X) with an amine of formula (XI).



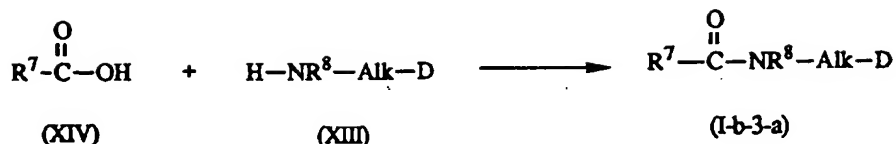
[0047] In (XI) R^9 and R^{10} have the same meanings as described hereinbefore. W^3 is an appropriate leaving group such as, for example, halo, e.g. chloro or bromo; hydroxy; C_{1-6} alkyloxy or C_{1-6} alkylthio, e.g. methoxy or methylthio.

[0048] The compounds of formula (I) wherein L is a radical of formula (b-4) and Y is NR^8 , said compounds being represented by (I-b-4-a), can also be prepared by reacting an amide of formula (XII) with an amine of formula (XIII). W^4 is an appropriate leaving group such as, for example, hydroxy; C_{1-6} alkyloxy, e.g. methoxy.



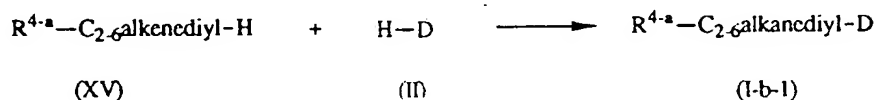
[0049] The reactions of (XI) with (X) and (XII) with (XIII) are conveniently conducted in a suitable reaction-inert solvent, such as, for example, a hydrocarbon, e.g. benzene, methylbenzene; a ketone, e.g. acetone; a halogenated hydrocarbon, e.g. dichloromethane, trichloromethane; an ether, e.g. 1,1'-oxybisethane, tetrahydrofuran and the like; a polar aprotic solvent, e.g. *N,N*-dimethylacetamide, *N,N*-dimethylformamide or a mixture of such solvents. An appropriate base such as for example, an alkali metal carbonate, sodium hydride or an organic base such as for example, *N,N*-diethylethanamine or *N*-(1-methylethyl)-2-propanamine may be utilized to pick up the acid which is liberated during the course of the reaction. Somewhat elevated temperatures may enhance the rate of the reaction.

[0050] The compounds of formula (I) wherein L is a radical of formula (b-3) and Y is NR^8 , said compounds being represented by formula (I-b-3-a), may also be prepared by reacting a carboxylic acid of formula (XIV) or a functional derivative with an amine of formula (XIII).



[0051] The reaction of (XIV) with (XIII) may generally be conducted following the same procedures as previously described for the amidation reaction of (V) with (IV).

[0052] The compounds of formula (I) wherein L is a radical of formula (b-1) wherein R^4 represents cyano, aryl or Het, said radical being represented by R^{4-a} and said compounds by (I-b-1), can also be prepared by the addition reaction of a piperidine of formula (II) with an alkene of formula (XV) in a reaction-inert solvent such as, for example, and aromatic hydrocarbon, e.g. benzene, methylbenzene and the like, an alkanol, e.g. methanol, ethanol, 2-propanol and the like, a ketone, e.g. 2-propanone and the like, an ether, e.g. tetrahydrofuran and the like, or a mixture of such solvents.



[0053] The compounds of formula (I) wherein L is a radical of formula (b-2) wherein X is O and R^5 is H or C_{1-6} alkyl, said radical being represented by R^{5-b} and said compounds by (I-b-2-c) can be prepared by reacting a piperidine of formula (II) with an epoxide of formula (XVI).



[0054] The reaction may be conducted by stirring and, if desired, heating the reactants in a reaction-inert solvent such as, for example, water, a ketone, e.g. 2-propanone, 4-methyl-2-pentanone; an ether, e.g. tetrahydrofuran, 1,1'-oxybisethane; an alcohol, e.g. methanol, ethanol, 1-butanol; a dipolar aprotic solvent, e.g. *N,N*-dimethylformamide, *N,N*-dimethylacetamide, and the like, or a mixture of such solvents.

[0055] The compounds of formula (I) can also be converted into each other following art-known procedures of functional group transformation. Some examples of such procedures will be cited hereinafter.

[0056] Compounds of formula (I) containing a hydroxy function may be *O*-alkylated according to art-known *O*-alkylation procedures, e.g. by stirring the former with an appropriate alkylating agent, if desired, in the presence of a base and a solvent.

[0057] Compounds of formula (I) bearing a protective dioxolan ring may be deacetalized to yield the corresponding oxo compounds. Said deacetalization may be conducted following procedures widely known in the art such as, for example, by reacting the starting materials in an acidic aqueous medium.

[0058] The compounds of formula (I) containing a cyano substituent can be converted into the corresponding amines by stirring and, if desired, heating the starting cyano compounds in a hydrogen containing medium in the presence of an appropriate catalyst such as, for example, platinum-on-charcoal, Raney nickel and the like catalysts and optionally in the presence of a base such as, for example, an amine e.g. *N,N*-diethylethanamine and the like, or a hydroxide, e.g. sodium hydroxide and the like. Suitable solvents are, for example, alkanols, e.g. methanol, ethanol and the like; ethers, e.g. tetrahydrofuran and the like or a mixture of such solvents.

[0059] The compounds of formula (I) containing an amino group can also be prepared by treating a carbamate with

a base, such as, for example, a hydroxide, e.g. potassium hydroxide, sodium hydroxide and the like. Suitable solvents are alkanols, e.g. methanol, 2-propanol and the like; ethers, e.g. tetrahydrofuran and the like. Amino groups may be alkylated following art-known procedures such as, for example, *N*-alkylation, reductive *N*-alkylation and the like methods, as described hereinbefore.

[0060] The compounds of formula (I) containing an ester group may be converted into the corresponding carboxylic acids following art-known saponification procedures, e.g. by treating the starting compounds with an aqueous alkaline or an aqueous acidic solution.

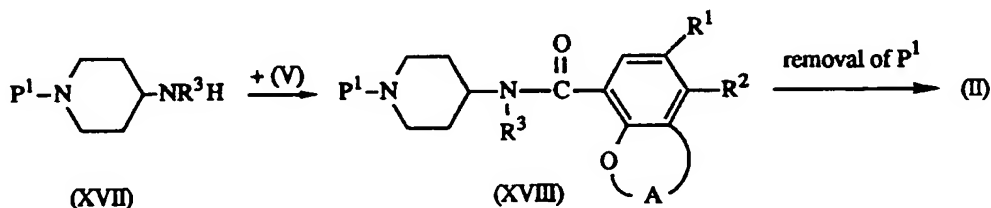
[0061] The compounds of formula (I) wherein R^1 is halo may be converted into compounds wherein R^1 is hydrogen following art-known hydrogenolysis procedures, e.g. by stirring and, if desired, heating the starting compounds in a suitable reaction-inert solvent in the presence of hydrogen and an appropriate catalyst such as, for example, palladium-on-charcoal and the like catalysts.

[0062] The compounds of formula (I) may also be converted to the corresponding *N*-oxide forms following art-known procedures for converting a trivalent nitrogen to its *N*-oxide-form. Said *N*-oxidation reaction may generally be carried out by reacting the starting material of formula (I) with an appropriate organic or inorganic peroxide. Appropriate inorganic peroxides comprise, for example, hydrogen peroxide, an alkali metal or earth alkaline metal peroxide, e.g. sodium peroxide, potassium peroxide, barium peroxide and the like; appropriate organic peroxides comprise peroxy acids such as, for example, benzenecarboperoxoic acid or halo substituted benzenecarboperoxoic acid, e.g. 3-chlorobenzenecarboperoxoic acid and the like, peroxyalkanoic acids, e.g. peroxyacetic acid and the like, alkylhydroperoxides, e.g. *t*-butyl hydroperoxide and the like.

Said *N*-oxidation may be carried out in a suitable solvent such as, for example, water, a lower alkanol, e.g. methanol, ethanol, propanol, butanol and the like; a hydrocarbon, e.g. benzene, methylbenzene, dimethylbenzene and the like; a ketone, e.g. 2-propanone, 2-butanone and the like, a halogenated hydrocarbon, e.g. dichloromethane, trichloromethane and the like or mixtures of such solvents. In order to enhance the reaction rate, it may be appropriate to heat the reaction mixture.

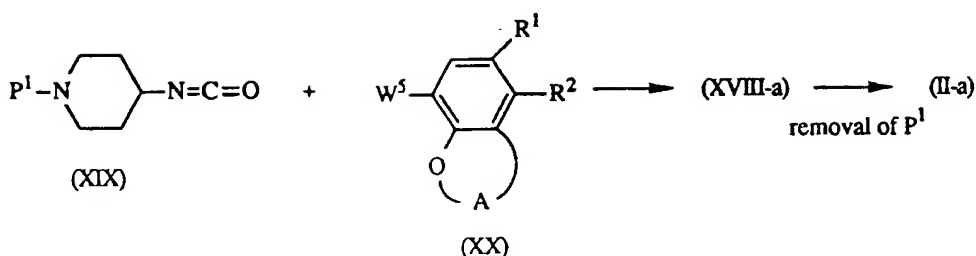
[0063] Some of the intermediates and starting materials in the foregoing preparations are known compounds while others are novel. They may be prepared according to art-known methodologies of preparing said known or similarly known compounds. Some of which are described in EP-A-0,389,037. The procedures for preparing some other intermediates will be described hereinafter in more detail.

[0064] The intermediates of formula (II) may be derived from an appropriately substituted piperidine of formula (XVII) by reacting the latter with a reagent of formula (V) or a functional derivative thereof, following the amidation procedures described for the preparation of (I) starting from (IV) and (V), and subsequently removing of the protective group P^1 in the thus obtained intermediate (XVIII) following art-known procedures, e.g. by hydrolysis in an acidic or an alkaline medium or by catalytic hydrogenation, depending upon the nature of P^1 .



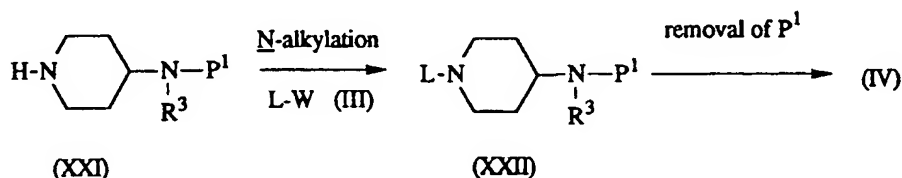
[0065] In the reaction of (XVII) with (V) and in the following reaction schemes P^1 represents a suitable protective group which is readily removable by hydrogenation or hydrolysis. Preferred protective groups may for example be, hydrogenolyzable groups, e.g. phenylmethyl and the like or hydrolyzable groups, such as C_{1-4} alkyloxycarbonyl, e.g. ethoxycarbonyl, benzyloxycarbonyl and the like.

[0066] The intermediates of formula (II) wherein R^3 is H, said intermediates being represented by formula (II-a), may alternatively be prepared as described in the following reaction scheme. Reaction of an isocyanate of formula (XIX) with an intermediate of formula (XX) yields an intermediate of formula (XVIII) wherein R^3 is H, said intermediate being represented by formula (XVIII-a). In formula (XX) W^5 is an alkali metal, e.g. lithium, sodium and the like; or halo magnesium e.g. magnesium bromide or magnesium chloride. The reaction can be carried out in a reaction-inert solvent such as, for example, an ether, e.g. tetrahydrofuran, 1,1'-oxybisethane, 1,2-dimethoxyethane and the like; a hydrocarbon, e.g. pentane, hexane and the like. The reaction can be carried out according to reaction procedures as described in Tetrahedron Letters, 22, 1971 (1986) or in J. Org. Chem., 32, 1273 (1967).

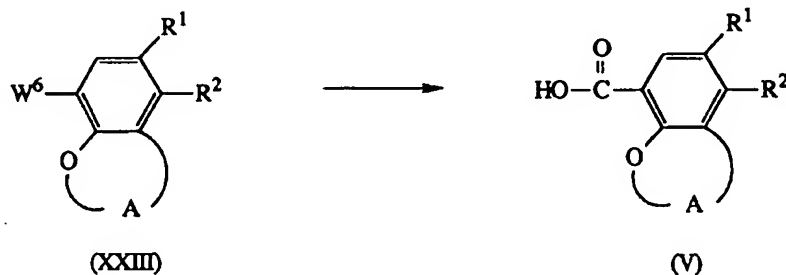


[0067] The thus obtained intermediates (XVIII-a) can be deprotected as described hereinabove to yield the intermediates of formula (II-a).

[0068] The intermediates of formula (IV) can be derived from an appropriately substituted piperidine of formula (XXI) by alkylating the latter with an appropriate reagent L-W (III), following the alkylation procedures described for (I) starting from (II) and (III) and, subsequently removing the protective group P¹ in the thus obtained intermediate (XXII) following art-known procedures described hereinbefore.

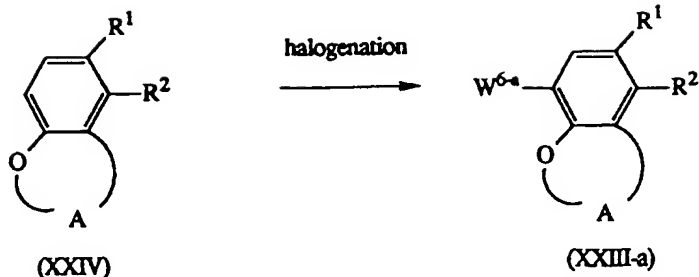


[0069] The carboxylic acids of formula (V) can be prepared from intermediates of formula (XXIII), by treating them with an alkyl lithium, e.g. n.butyl lithium, methyl lithium and the like; an alkali metal, e.g. lithium, sodium and the like; a transition metal, e.g. magnesium, zinc, cadmium and the like or an amide, e.g. sodium amide and the like, followed by treatment with CO₂ or a reagent of formula L¹-C(=O)-L¹. L¹ represents an appropriate leaving group such as, for example, C₁₋₆alkyloxy, halo and the like. In formula (XXIII) W⁶ represents hydrogen or an appropriate reactive leaving group such as, for example, halo, e.g. chloro, bromo or iodo.



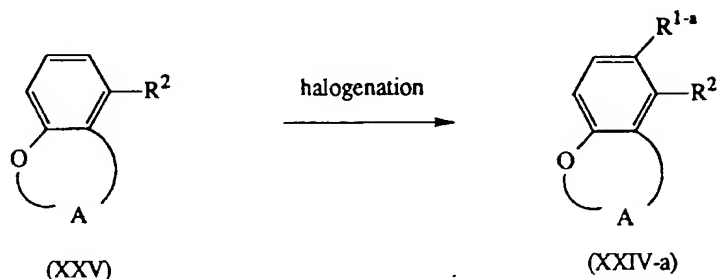
[0070] Said reaction can conveniently be carried out in a reaction-inert solvent such as for example, an aliphatic hydrocarbon, e.g. pentane, hexane, cyclohexane and the like; an aromatic solvent, e.g. benzene, chlorobenzene and the like; an ether, e.g. tetrahydrofuran, 1,4-dioxane and the like or a mixture of such solvents and optionally in the presence of an amine, e.g. ethanamine, N,N-diethylethanamine, N,N,N',N'-tetramethylethylenediamine and the like.

[0071] The intermediates of formula (XXIII) wherein W⁶ is a reactive leaving group, said W⁶ being represented by W^{6-a} and said intermediates being represented by (XXIII-a), can in turn be obtained from (XXIV) following art-known halogenation procedures optionally followed by the separation of the undesired isomers.



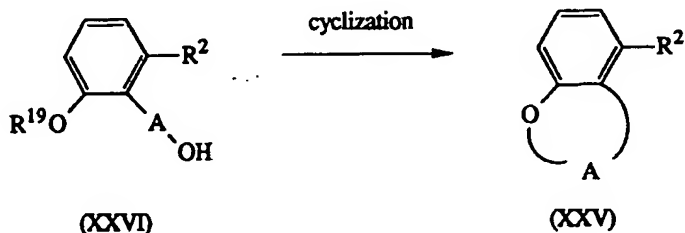
15 [0072] For example, an intermediate of formula (XXIV) can be halogenated with a dihalide, e.g. chlorine, bromine and the like, optionally in the presence of a catalyst such as, a Lewis acid, e.g. ferric chloride, ferric bromide, aluminum chloride and the like. Intermediate (XXIV) can also be halogenated with *N*-haloamides, e.g. *N*-chlorosuccinimide, *N*-bromosuccinimide and the like. In some instances the reaction can be catalyzed by the addition of acids, e.g. acetic acid, hydrochloric acid and the like. Said halogenation reactions can conveniently be carried out in a reaction-inert solvent such as, for example, water; an aliphatic hydrocarbon, e.g. pentane, hexane, cyclohexane and the like; an aromatic solvent, e.g. benzene, methylbenzene and the like; a halogenated hydrocarbon, e.g. dichloromethane, tetrachloromethane and the like; an ether, e.g. 1,1'-oxybisethane, tetrahydrofuran and the like; or a dipolar aprotic solvent, e.g. acetonitrile and the like.

20 [0073] The intermediates of formula (XXIV) wherein R^1 is other than hydrogen, said R^1 being represented by R^{1-a} and said intermediates by (XXIV-a), can be prepared by halogenation of an intermediate of formula (XXV).



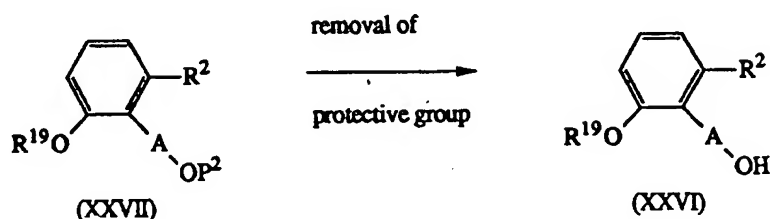
40 [0074] The halogenation reaction can be carried out according to the halogenation procedures described herein-above for the halogenation of (XXIV).

45 [0075] The starting materials of formula (XXV) can be obtained by cyclizing an intermediate of formula (XXVI) in the presence of boron tribromide or an acid such as, for example, hydrochloric acid, hydrobromic acid and the like, or mixtures of these acids with acetic acid.



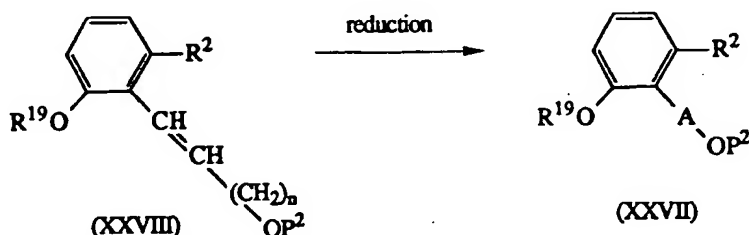
[0076] In intermediate (XXVI) and throughout the following description and reaction schemes R^{19} is C_{1-4} alkyl.

[0077] The intermediates of formula (XXVI), in turn, can be prepared by deprotecting the functionalized alcohol in intermediate (XXVII).



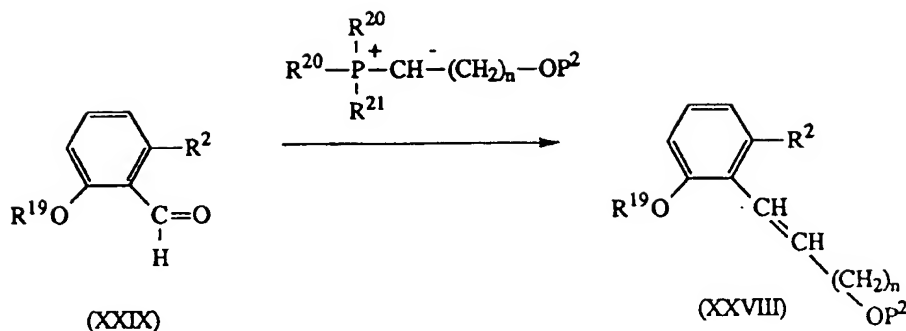
15 [0078] In formula (XXVII) P^2 is a protective group such as for example, tetrahydropyranyl, tertiary butyl, phenylmethyl and the like. These protective groups are readily removable by hydrolysis with for example, an acid, e.g. hydrochloric acid, hydrobromic acid, acetic acid and the like or by catalytic hydrogenation in the presence of hydrogen and an appropriate catalyst. In case R^2 is amino, it may be expedient to protect this group during the course of the above and the following reactions to avoid undesired side reactions. Suitable protective groups are, for example, C_{1-6} alkylcarbonyl, C_{1-6} alkyloxycarbonyl, benzyloxycarbonyl and arylmethyl groups. The removal of the protective group may generally be carried out by deblocking, for example, a C_{1-6} alkylcarbonyl group with an appropriate acid or base in an anhydric or aqueous organic solvent or in water; or by catalytic hydrogenation in the presence of hydrogen and an appropriate catalyst depending upon the nature of the protective group.

20 [0079] The intermediates of formula (XXVII) can be obtained by reduction of an intermediate of formula (XXVIII).



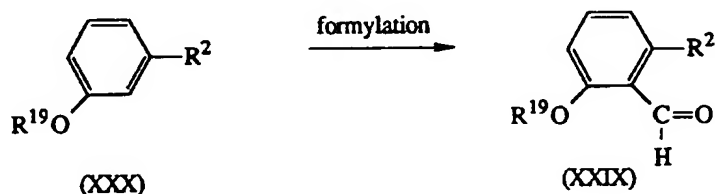
40 [0080] It is to be understood that in formula (XXVIII) and the subsequent formulae one or two hydrogen atoms of the carbon chain may be replaced by a C_{1-6} alkyl radical, and n can be 0, 1 or 2. The double bond of formula (XXVIII) may be reduced by catalytic hydrogenation in a suitable solvent, e.g. methanol or ethanol and the like in the presence of hydrogen and an appropriate catalyst e.g. platinum-on-charcoal, palladium-on-charcoal, Raney Nickel and the like, optionally at an increased temperature and/or pressure.

45 [0081] The intermediates of formula (XXVIII) can be prepared by reacting an aldehyde (XXIX) with a suitable ylide such as, for example, a phosphorus ylide (e.g. R^{20} and R^{21} are aryl or alkyl: Wittig reaction) or an ylide prepared from a phosphonate (e.g. R^{20} is alkoxy and R^{21} is O^- : Horner-Emmons reaction).



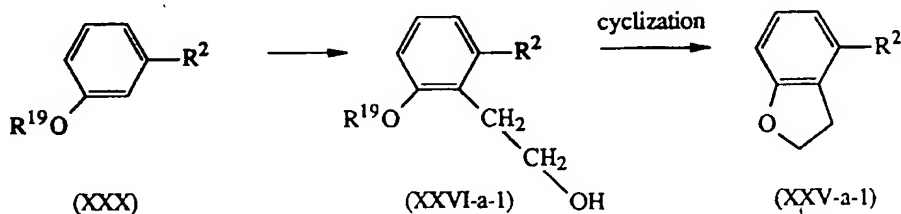
[0082] Said ylide can be obtained by treating a phosphonium salt or a phosphonate with an appropriate base such as, for example, potassium tert. butoxide, n.butyl lithium, sodium amide, sodium hydride and the like bases under an inert atmosphere and in a reaction-inert solvent such as, for example, an ether, e.g. tetrahydrofuran, 1,4-dioxane and the like.

[0083] The intermediates of formula (XXIX) can conveniently be obtained from an alkoxybenzene derivative of formula (XXX) following art-known formylation procedures, optionally followed by the separation of the undesired isomers.



[0084] For example, the alkoxybenzene derivative of formula (XXX) can be formylated by reaction with an appropriate base such as, for example, an alkyl lithium, e.g. methyl lithium, n.butyl lithium, and the like, and subsequently reacting the thus obtained metalated alkoxybenzene derivative with a formamide, e.g. *N,N*-dimethylformamide, *N*-methyl-*N*-phenylformamide, and the like. Said formylation may also be conducted under Vilsmeier-Haack (phosphoryl chloride, formamide) or Gattermann (zinc(II)-cyanide, hydrochloric acid) conditions in an acidic medium.

[0085] Alternatively, the starting materials of formula (XXV), wherein A is -CH₂-CH₂-, wherein one or two hydrogen atoms may be replaced by C₁₋₆alkyl, said intermediates being represented by formula (XXV-a-1), can be obtained by cyclizing an intermediate of formula (XXVI-a-1) in an acidic medium according to the procedures described in J. Het. Chem., 17, 1333 (1980).

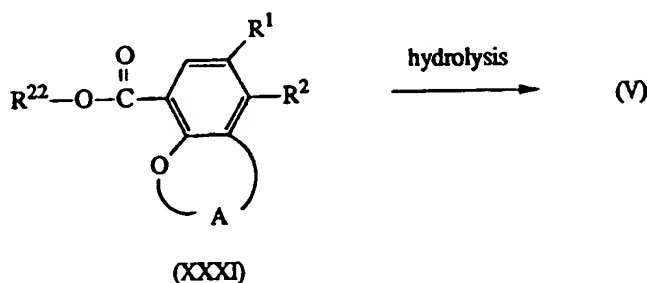


[0086] It is to be understood that in formula (XXVI-a-1) and (XXV-a-1) one or two hydrogen atoms of the ethyl or tetrahydrofuran moiety may be replaced by a C₁₋₆alkyl radical.

[0087] The desired intermediates of formula (XXVI-a-1) can be obtained from an alkoxybenzene derivative of formula (XXX) by reacting the latter with an ethylene oxide derivative in a reaction inert solvent such as, for example, an

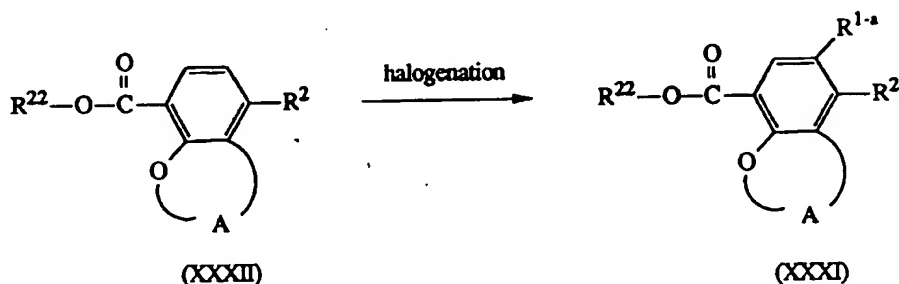
ether, e.g. tetrahydrofuran, 1,4-dioxane, and the like in the presence of a base. Appropriate bases are, for example, alkyl lithium, e.g. methyl lithium, n.butyl lithium and the like.

[0088] The intermediates of formula (V) can also be prepared by hydrolyzing the ester group of formula (XXXI) in a basic or acidic aqueous medium.

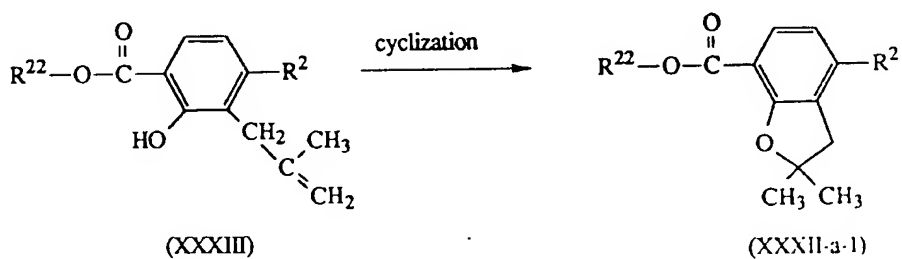


[0089] In (XXXI) and throughout the following description and reaction schemes R^{22} is a C_{1-4} alkyl radical.

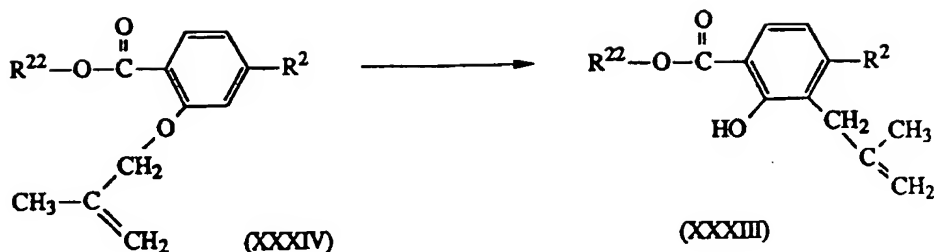
[0090] The above esters of formula (XXXI) in turn can be obtained by halogenation of the intermediates of formula (XXXII) according to the procedures described hereinbefore for the preparation of the intermediates of formula (XXIII-a) from (XXIV).



[0091] The intermediates of formula (XXXII), wherein A is $-C(CH_3)_2-CH_2-$, said intermediates being represented by formula (XXXII-a-1) can be obtained by cyclizing the phenyl allyl intermediate (XXXIII), in the presence of an acid, for example, formic acid, acetic acid, hydrogen bromide and the like, or a mixture of these acids.

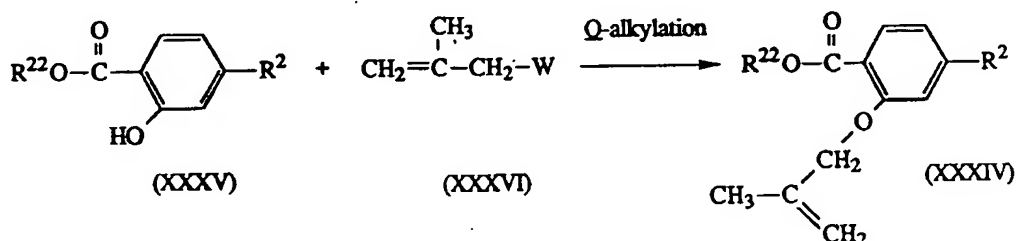


[0092] The above phenyl allyl intermediate (XXXIII) can be prepared by a Claisen rearrangement of a phenyl allyl ether of formula (XXXIV).



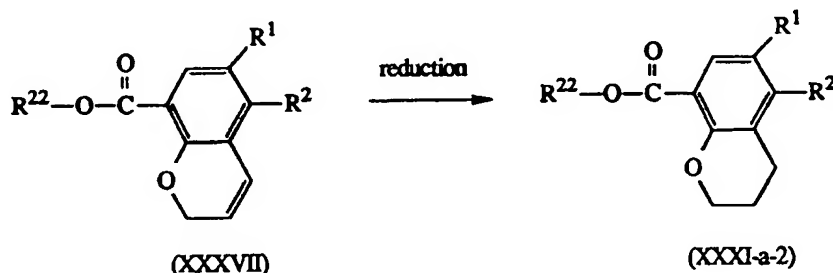
[0093] Said reaction can be carried out in a reaction-inert solvent at a somewhat elevated temperature, in particular the reflux temperature of the reaction mixture. Suitable solvents are, for example, aliphatic or aromatic hydrocarbons, e.g. methylbenzene, phenylbenzene and the like, halogenated hydrocarbons, e.g. chlorobenzene and the like, alcohols, e.g. cyclohexanol and the like, ethers, e.g. 1,1'-oxybisethane, 1,1'-oxybisbenzene and the like, amines, e.g. *N,N*-dimethylaniline and the like; dipolar aprotic solvents, e.g. *N,N*-dimethylformamide, 1-methyl-2-pyrrolidinone and the like.

[0094] The phenyl allyl ether of formula (XXXIV) can in turn be prepared by the *O*-alkylation reaction of a phenol intermediate of formula (XXXV) with an alkylating reagent of formula (XXXVI) following art-known *O*-alkylation procedures.



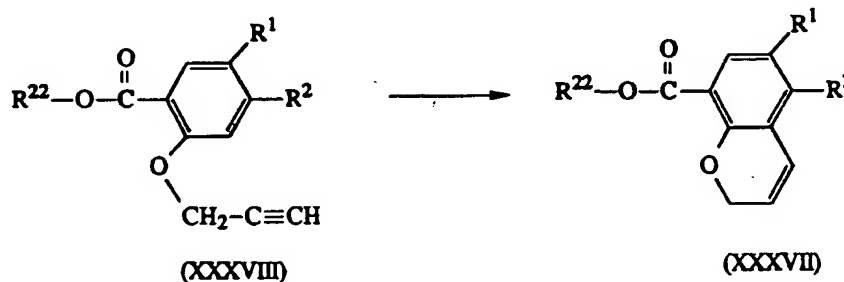
[0095] In formula (XXXVI) W is defined as described hereinbefore for intermediate (III). Said *O*-alkylation reaction can conveniently be carried out by mixing the reactants, optionally in a reaction-inert solvent such as, for example, water; an aromatic solvent, e.g. benzene and the like; a C_{1-6} alkanol, e.g. ethanol and the like; a ketone, e.g. 2-propanone and the like; an ether, e.g. tetrahydrofuran and the like; or a dipolar aprotic solvent, e.g. *N,N*-dimethylformamide and the like. The addition of an appropriate base such as, for example potassium carbonate, sodium hydroxide or sodium hydride and the like may optionally be used to pick up the acid which is formed during the course of the reaction.

[0096] The intermediates of formula (XXXI), wherein A is $-\text{CH}_2-\text{CH}_2-\text{CH}_2-$, wherein one or two hydrogen atoms may be replaced by C_{1-6} alkyl, said intermediates being represented by formula (XXXI-a-2), can be obtained by reduction of a 2H-benzopyran of formula (XXXVII) following the reduction procedures described hereinbefore for the preparation of the intermediates of formula (XXVII).



[0097] It is to be understood that in formula (XXXI-a-2) and the subsequent formulae (XXXVII) and (XXXVIII) one or two hydrogen atoms of the pyran moiety or the carbon chain may be replaced by C₁₋₆alkyl.

[0098] The intermediates of formula (XXXVII) can be prepared by a Claisen rearrangement of a phenylether of formula (XXXVIII) followed by a cyclization reaction.



[0099] Said reaction can be carried out according to reaction procedures as described in Elderfield, Heterocyclic Compounds, Vol. 2, pages 393-418. Preferably the rearrangement is carried out in a reaction-inert solvent at temperatures above 100°C. Suitable solvents are for example, hydrocarbons, e.g. phenylbenzene, diphenylmethane, naphthalene, decahydronaphthalene and the like; halogenated hydrocarbons, e.g. chlorobenzene and the like; alcohols, e.g. cyclohexanol and the like; ethers, e.g. 1,1'-oxybisbenzene and the like; or dipolar aprotic solvents, e.g. *N,N*-dimethylacetamide, *N,N*-dimethylformamide and the like.

[0100] The above described intermediates can also be converted into each other following art-known procedures of functional group transformation as described hereinbefore for the compounds of formula (I).

[0101] The intermediates of formula (II) and (XVIII) wherein R¹, R², R³, A and P¹ have the above described meanings are deemed to be novel, and as such they represent an additional feature of the present invention.

[0102] The compounds of formula (I) may have asymmetric carbon atoms in their structure. The absolute configuration of these centres may be indicated by the stereochemical descriptors R and S. Unless otherwise mentioned or indicated, the chemical designation of compounds denotes the mixture of all possible stereochemically isomeric forms, said mixtures containing all diastereomers and enantiomers of the basic molecular structure. Stereochemically isomeric forms, as well as mixtures thereof, are obviously intended to be embraced within the scope of the invention.

[0103] The compounds of formula (I) containing an alkene moiety may be present in a "E" or "Z" form, said E- and Z-notation having the meanings described in J. Org. Chem., 35, 2849-2868 (1970).

[0104] Stereochemically isomeric forms of the intermediates described in the foregoing reaction schemes and of the compounds of formula (I) may be obtained by the application of art-known procedures. For example, diastereoisomers may be separated by physical separation methods such as distillation, selective crystallization, chromatographic techniques, e.g. counter current distribution, liquid chromatography and the like techniques. Pure enantiomers may be obtained by separating the corresponding racemates for example, by the selective crystallization of their diastereomeric salts with optically active resolving agents, chromatography of diastereomeric derivatives, chromatography of the racemate over a chiral stationary phase and the like techniques. Alternatively, enantiomerically pure forms can conveniently be obtained from the enantiomerically pure isomeric forms of the appropriate starting materials, provided that the subsequent reactions occur stereospecifically.

[0105] The compounds of formula (I) and the intermediates of formula (II), the *N*-oxide forms, the pharmaceutically acceptable salts and possible stereoisomeric forms thereof possess favourable gastrointestinal motility stimulating properties. In particular the present compounds show significant motility enhancing effects on the colon. The latter property is clearly evidenced by the results obtained in the "colon ascends induced contractions" test described hereinafter.

[0106] The stimulatory effect of the subject compounds of formula (I) and (II) on the motility of the gastrointestinal system may further be evidenced by, for example, the various test models described in The Journal of Pharmacology and Experimental Therapeutics, 234, 775-783 (1985) and in Drug Development Research 8, 243-250 (1986). The "Gastric emptying of a liquid meal in rats" test, the "Gastric emptying of an acaaloric meal in conscious dog after administration of lidamidine" test and the "Amplification of contractions induced by transdermal stimulation of Guinea pig ileum" test, all of which are described in the above mentioned articles, further revealed that a representative number of compounds also significantly accelerated gastric emptying.

[0107] In addition, some of the compounds of formula (I) and (II), the *N*-oxide forms, the pharmaceutically acceptable acid addition salts and possible stereoisomeric forms thereof have a particular receptor binding profile. Some

groups of compounds within the present invention, particularly those wherein the radical A is not substituted with C₁-alkyl have a poor 5HT₃ antagonistic activity. Most compounds of the invention do not show any apparent marked receptor-binding affinity with serotonergic-5HT₁ and serotonergic-5HT₂ receptors and have little or no dopaminergic antagonistic activity.

[0108] In view of their useful gastrointestinal motility enhancing properties the subject compounds may be formulated into various forms for administration purposes.

[0109] To prepare the pharmaceutical compositions of this invention, an effective amount of the particular compound, in base or acid addition salt form, as the active ingredient is combined in intimate admixture with a pharmaceutically acceptable carrier, which carrier may take a wide variety of forms depending on the form of preparation desired for administration. These pharmaceutical compositions are desirably in unitary dosage form suitable, preferably, for administration orally, rectally or by parenteral injection. For example, in preparing the compositions in oral dosage form, any of the usual pharmaceutical media may be employed, such as, for example, water, glycols, oils, alcohols and the like in the case of oral liquid preparations such as suspensions, syrups, elixirs and solutions; or solid carriers such as starches, sugars, kaolin, lubricants, binders, disintegrating agents and the like in the case of powders, pills, capsules and tablets. Because of their ease in administration, tablets and capsules represent the most advantageous oral dosage unit form, in which case solid pharmaceutical carriers are obviously employed. For parenteral compositions, the carrier will usually comprise sterile water, at least in large part, though other ingredients, for example, to aid solubility, may be included. Injectable solutions, for example, may be prepared in which the carrier comprises saline solution, glucose solution or a mixture of saline and glucose solution. Injectable suspensions may also be prepared in which case appropriate liquid carriers, suspending agents and the like may be employed. In the compositions suitable for percutaneous administration, the carrier optionally comprises a penetration enhancing agent and/or a suitable wetting agent, optionally combined with suitable additives of any nature in minor proportions, which additives do not cause a significant deleterious effect to the skin. Said additives may facilitate the administration to the skin and/or may be helpful for preparing the desired compositions. These compositions may be administered in various ways, e.g., as a transdermal patch, as a spot-on, as an ointment. Acid addition salts of (I) due to their increased water solubility over the corresponding base form, are obviously more suitable in the preparation of aqueous compositions.

[0110] It is especially advantageous to formulate the aforementioned pharmaceutical compositions in dosage unit form for ease of administration and uniformity of dosage. Dosage unit form as used in the specification and claims herein refers to physically discrete units suitable as unitary dosages, each unit containing a predetermined quantity of active ingredient calculated to produce the desired therapeutic effect in association with the required pharmaceutical carrier. Examples of such dosage unit forms are tablets (including scored or coated tablets), capsules, pills, powder packets, wafers, injectable solutions or suspensions, teaspoonfuls, tablespoons and the like, and segregated multiples thereof.

[0111] In view of their capability to stimulate the motility of the gastrointestinal system and, in particular their capacity to enhance the mobility of the colon, the subject compounds are useful to normalize or to improve the gastric and intestinal emptying in subjects suffering from a disturbed motility, e.g. a decreased peristalsis of the stomach and/or of the small and/or large intestine.

[0112] In view of the utility of the compounds of the present invention, there is provided a method of treating warm-blooded animals suffering from motility disorders of the gastrointestinal system such as, for example, gastroparesis, flatulent dyspepsia, non-ulcer dyspepsia, pseudo-obstruction, and in particular impaired colonic transit. Said method comprises the systemic administration of an effective gastrointestinal motor-stimulating amount of a compound of formula (I), a N-oxide, a pharmaceutically acceptable acid addition salt or a possible stereoisomeric form thereof, to warm-blooded animals. Some particular compounds of the invention also possess therapeutic value in the treatment of upper bowel motility and gastroesophageal reflux disorders.

[0113] Those of skill in the pertinent art could easily determine the effective motor-stimulating amount from the test results presented hereinafter.

[0114] In general it is contemplated that an effective amount would be from 0.001 mg/kg to 10 mg/kg body weight, and more preferably from 0.01 mg/kg to 1 mg/kg body weight.

[0115] The following examples are intended to illustrate and not to limit the invention in all its aspects. Unless otherwise stated all parts therein are by weight.

Experimental PartA. Preparation of the intermediates5 Example 1

[0116]

- 10 a) To a solution of 310 parts of methyl 4-(acetylamino)-2-hydroxybenzoate in 2820 parts of *N,N*-dimethylformamide there were added portionwise 71 parts of a dispersion of sodium hydride in mineral oil (50%) and, after stirring for 1 hour at room temperature, one crystal of potassium iodide and 172 parts of 3-chloro-3-methyl-1-butyne under a nitrogen atmosphere. The whole was stirred for 24 hours at 90°C and was then poured into NaOH 10% (aq.). The product was extracted with dichloromethane and the extract was dried, filtered and evaporated. The residue was successively stirred in petroleumether and dissolved in dichloromethane. The latter solution was washed with
- 15 water, NaOH 10% and water and was then dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂). The eluent of the desired fraction was evaporated, yielding in two fractions 41 parts (10.1%) of methyl 4-(acetylamino)-2-(1,1-dimethyl-2-propynyloxy)benzoate (interm. 1).
- 20 b) A mixture of 36 parts of intermediate 1 and 188 parts of *N,N*-dimethylacetamide was stirred for 24 hours at reflux temperature. The reaction mixture was evaporated and the residue was dissolved in dichloromethane. This solution was washed with water, NaOH 5% and water and was then dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 99:1). The eluent of the desired fraction was evaporated, yielding 23.7 parts (66.2%) of methyl 5-(acetylamino)-2,2-dimethyl-2H-1-benzopyran-8-carboxylate (interm. 2).
- 25 c) A mixture of 23.7 parts of intermediate 2 and 198 parts of methanol was hydrogenated overnight at normal pressure and room temperature with 2 parts of palladium-on-charcoal catalyst 10%. After the calculated amount of hydrogen was taken up, the catalyst was filtered off and the filtrate was evaporated, yielding 21.2 parts (88.9%) of methyl 5-(acetylamino)-3,4-dihydro-2,2-dimethyl-2H-1-benzopyran-8-carboxylate (interm. 3).
- 30 d) A mixture of 21.2 parts of intermediate 3; 10.3 parts of *N*-chlorosuccinimide and 158 parts of acetonitrile was stirred for 2 hours at reflux temperature. The reaction mixture was evaporated and the residue was dissolved in dichloromethane. This solution was washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 99:1). The eluent of the desired fraction was evaporated, yielding 23 parts (95.8%) of methyl 5-(acetylamino)-6-chloro-3,4-dihydro-2,2-dimethyl-2H-1-benzopyran-8-carboxylate (interm. 4).
- 35 e) A mixture of 20 parts of intermediate 4; 36 parts of potassium hydroxide and 250 parts of water was stirred for 16 hours at reflux temperature. After cooling, the solvent was decanted and the residue was washed with dichloromethane (2x). The aqueous layer was acidified with 69.9 parts of HCl (conc.). The precipitate was filtered off, washed with water and dried in vacuo at 70°C, yielding 13 parts (79.4%) of 5-amino-chloro-3,4-dihydro-2,2-dimethyl-2H-1-benzopyran-8-carboxylic acid; mp. 165°C (interm. 5).

Example 2

40

[0117]

- 45 a) A mixture of 58 parts of methyl 4-(acetylamino)-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxylate, 123 parts of potassium hydroxide and 1100 parts of water was stirred for 3 hours at reflux temperature. After cooling, the reaction mixture was acidified to pH 1 with HCl. The precipitate was filtered off and dried in vacuo at 80°C, yielding 36 parts (79.0%) of 4-amino-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxylic acid (interm. 6).
- 50 b) A mixture of 36 parts of intermediate 6; 66.2 parts of sulfuric acid and 142 parts of methanol was stirred for 1/2 hour at reflux temperature. After cooling, the reaction mixture was basified with methanol saturated with ammonia, and was then evaporated. The residue was partitioned between dichloromethane and water. The organic layer was separated, washed with water, dried, filtered and evaporated. The residue was crystallized from acetonitrile at 0°C. The product was filtered off and dried in vacuo at 40°C, yielding 20 parts (53.2%) of methyl 4-amino-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxylate (interm. 7).
- 55 c) A mixture of 15.3 parts of intermediate 7; 23.3 parts of 2-iodopropane, 9.13 parts of *N,N*-diethylethanamine and 72.1 parts of hexamethylphosphoric triamide was stirred for 28 hours at 130°C. After cooling, the reaction mixture was poured into water. The product was extracted with dichloromethane and the extract was washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 99:1). The eluent of the desired fraction was evaporated and the residue was crystallized from 2,2'-oxybispropane at 0°C. The product was filtered off and dried in vacuo at 40°C, yielding 10 parts (54.2%) of methyl 2,3-dihydro-2,2-

dimethyl-4-[(1-methylethyl)amino]-7-benzofurancarboxylate (interm. 8).

d) A mixture of 9 parts of intermediate 8; 3.2 parts of sodium hydroxide and 60 parts of water was stirred for 1 hour at reflux temperature. After cooling, the reaction mixture was acidified to pH 6 with HCl (conc.). The precipitate was filtered off, washed with water and dried in vacuo at 60°C, yielding 7.2 parts (76.0%) of 2,3-dihydro-2,2-dimethyl-4-[(1-methylethyl)amino]-7-benzofurancarboxylic acid (interm. 9).

Example 3

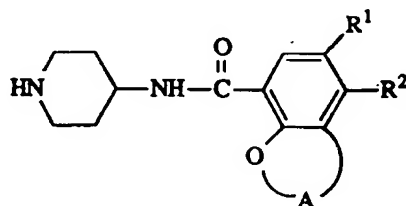
[0118]

a) To a suspension of 17.0 parts of 4-amino-5-chloro-2,3-dihydro-7-benzofurancarboxylic acid (prepared as described in EP-A-0,389,037) in 435 parts of trichloromethane there were added successively 9.13 parts of *N,N*-diethylethanamine and 8.68 parts of ethyl chloroformate, keeping the temperature below 5°C. After stirring for 2 hours while cooling on ice, the whole was added to a solution of 14.5 parts of ethyl 4-amino-1-piperidinecarboxylate in 218 parts of trichloromethane at a temperature below 5°C. Stirring was continued overnight at room temperature. The reaction mixture was washed with NaOH 5% (2x) and with water (2x) and was then dried, filtered and evaporated. The residue was successively triturated with 2,2'-oxybispropane (3x) and crystallized from acetonitrile. The product was filtered off, washed with acetonitrile and dried, yielding 19.7 parts (66.9%) of product. An additional amount of 1.2 parts (4.1%) was obtained from the combined 2,2'-oxybispropane layers. Total yield: 20.9 parts (71%) of ethyl 4-[[[(4-amino-5-chloro-2,3-dihydro-7-benzofuranyl)carbonyl]amino]-1-piperidine-carboxylate; mp. 158.6°C (interm. 10).

b) A solution of 18.4 parts of intermediate 10 and 28.0 parts of potassium hydroxide in 125 parts of 2-propanol was stirred for 4 hours at reflux temperature. The solvent was evaporated and replaced by 100 parts of water. The mixture was evaporated again and the residue was stirred in 100 parts of water for 15 min. while heating on a water-bath. After cooling, the solid was filtered off, washed with water and dissolved in boiling 2-propanol. There were added 400 parts of water to the solution. The product crystallized upon cooling and was filtered off, washed with water and dried, yielding 12.35 parts (83.5%) of 4-amino-5-chloro-2,3-dihydro-*N*-(4-piperidinyl)-7-benzofurancarboxamide; mp. 190.3°C (interm. 11).

All intermediates listed in Table 1 were prepared in a similar manner.

Table 1



Int. No.	R ¹	R ²	-O-A-	Physical data (mp.)
11	Cl	NH ₂	-O-(CH ₂) ₂ -	190.3°C
12	Cl	NH ₂	-O-(CH ₂) ₃ -	158.5°C
13	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	137.5°C
14	Cl	NH ₂	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	170.8°C
15	Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	173.6°C
16	Cl	H	-O-(CH ₂) ₂ -	-
17	Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	126.3°C
18	H	NH-CH(CH ₃) ₂	-O-C(CH ₃) ₂ -CH ₂ -	-

Example 4

5 [0119] To a stirred and cooled (ice-bath) mixture of 20 parts of (-)-(R)-tetrahydro-2-furanmethanol and 39.2 parts of pyridine there were added dropwise 24.7 parts of methanesulfonyl chloride. Stirring at room temperature was continued for 16 hours. To the reaction mixture there was added dichloromethane and the whole was washed with HCl 1N, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 99.5:0.5). The eluent of the desired fraction was evaporated, yielding 26.7 parts (75.6% of (-)-(R)-tetrahydro-2-furanmethanol methanesulfonate (ester); $[\alpha]_D^{20} = -15.78^\circ$ (conc. = 1% in CH₂Cl₂) (interm. 19).

10 In a similar manner there was also prepared :

(+)-(S)-tetrahydro-2-furanmethanol methanesulfonate(ester); $[\alpha]_D^{20} = +16.17^\circ$ (conc. = 1% in CH₂Cl₂) (interm. 20).

Example 5

15 [0120] To a solution of 10 parts of 3-(cyclohexyloxy)-1-propanol in 160 parts of dichloromethane there were added 11.2 parts of N,N-diethylethanamine and dropwise 8.14 parts of methanesulfonyl chloride. The whole was stirred for 9 hours at room temperature. The reaction mixture was washed with Na₂CO₃ (aq.) and water and was then dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 99:1). The eluent of the desired fraction was evaporated and the residue was co-evaporated with methylbenzene. The product was filtered off and dried, yielding 8.6 parts (57.8%) of 3-(cyclohexyloxy)-1-propanol methanesulfonate (ester) (interm. 21).

Example 6

25 [0121] A solution of 5.5 parts of 3,3-bis(4-fluorophenyl)-1-propanol and 2.92 parts of thionyl chloride in 39.9 parts of dichloromethane was stirred for 4 hours at 60°C. The reaction mixture was evaporated and then co-evaporated with methylbenzene. The residue was dissolved in ethyl acetate and this solution was washed with Na₂CO₃ (aq.), water and NaCl (sat.) and was then dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; (C₂H₅)₂O / n. hexane 2:98). The eluent of the desired fraction was evaporated, yielding 4.5 parts (76.7%) of 1-[3-chloro-1-(4-fluorophenyl)propyl]-4-fluorobenzene (interm. 22.).

B. Preparation of the final compoundsExample 7

35 [0122] A solution of 2.96 parts of intermediate 11; 3.2 parts of sodium carbonate and 160 parts of 4-methyl-2-pentanone was stirred for 1/2 hour at reflux temperature using a water separator. There were added 3.6 parts of tetrahydro-2-furanmethanol methanesulfonate (ester) and stirring at reflux temperature was continued for 48 hours. The reaction mixture was taken up in dichloromethane and this solution was washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 95:5). The eluent of the desired fraction was evaporated and the residue was crystallized from acetonitrile. The product was filtered off and dried, yielding 1.63 parts (42.9%) of 4-amino-5-chloro-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarboxamide; mp. 175.4°C (comp. 3).

45 Example 8

[0123] A mixture of 3.09 parts of intermediate 12; 3.18 parts of sodium carbonate and 160 parts of 4-methyl-2-pentanone was stirred at reflux temperature using a water separator. There were added 2.74 parts of 6-(2-chloroethyl)-7-methyl-5H-thiazolo[3,2-a]pyrimidin-5-one and 0.1 parts of potassium iodide and stirring at reflux temperature was continued for 36 hours. The reaction mixture was evaporated and the residue was partitioned between trichloromethane and water. The organic layer was separated, washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH 90:10). The eluent of the desired fraction was evaporated and the residue was boiled in acetonitrile. After cooling, the product was filtered off and dried, yielding 2.7 parts (53.8%) of 5-amino-6-chloro-3,4-dihydro-N-[1-[2-(7-methyl-5-oxo-5H-thiazolo[3,2a]pyrimidin-6-yl)ethyl]-4-piperidinyl]-2H-1-benzopyran-8-carboxamide; mp. 211.8°C (comp. 2.)

Example 9

[0124] A mixture of 21.7 parts of intermediate 12; 5.7 parts of chloroacetonitrile, 9.2 parts of *N,N*-diethylethanamine and 430 parts of *N,N*-dimethylformamide was stirred overnight at 60°C. The reaction mixture was evaporated and to the residue there was added Na₂CO₃ (aq.). The product was extracted with dichloromethane (3x) and the combined extracts were dried, filtered and evaporated. The residue was suspended in acetonitrile. A first fraction of the product was filtered off and the filtrate was evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 97:3). The eluent of the desired fractions was evaporated and the residue was stirred in acetonitrile. A second fraction of the product was obtained and the combined fractions were dried in vacuo, yielding 22.1 parts (90.5%) of 5-amino-6-chloro-*N*-[1-(cyanomethyl)-4-piperidiny]-3,4-dihydro-2*H*-1-benzopyran-8-carboxamide; mp. 194°C (comp. 10).

Example 10

[0125] A mixture of 4.3 parts of 2-(3-chloropropyl)-2-methyl-1,3-dioxolane, 7.4 parts of intermediate 13; 4.7 parts of *N,N*-diethylethanamine, a catalytic amount of potassium iodide and 106 parts of *N,N*-dimethylformamide was stirred for 17 hours at 70°C. The reaction mixture was evaporated and to the residue there was added Na₂CO₃ (aq.). The product was extracted with dichloromethane and the extract was dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 97:3). The eluent of the desired fraction was evaporated and the residue was triturated in 2,2'-oxybispropane. The product was filtered off and dried, yielding 2.1 parts (20.2%) of 4-amino-5-chloro-2,3-dihydro-2,2-dimethyl-*N*-[1-[3-(2-methyl-1,3-dioxolan-2-yl)propyl]-4-piperidiny]-7-benzofurancarboxamide; mp. 136.5°C (comp. 8).

Example 11

[0126] A mixture of 6 parts of intermediate 14; 1.13 parts of 2-propenenitrile and 78 parts of 2-propanol was stirred for 4 hours at reflux temperature. The reaction mixture was evaporated and the residue was suspended in 2,2'-oxybispropane. The precipitate was filtered off and dried in vacuo at 60°C, yielding 6.8 parts (96.6%) of 5-amino-6-chloro-*N*-[1-(2-cyanoethyl)-4-piperidiny]-3,4-dihydro-2,2-dimethyl-2*H*-1-benzopyran-8-carboxamide (comp. 25).

Example 12

[0127] A mixture of 22 parts of compound 10 in 356 parts of tetrahydrofuran and 79 parts of methanol was reduced at normal pressure and room temperature with 6 parts of Raney nickel. After completion of the reaction, the catalyst was filtered off and the filtrate was evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 93:7). The eluent of the desired fraction was evaporated and the residue was successively triturated in 2,2'-oxybispropane and stirred in a small amount of acetonitrile. The product was filtered off and dried, yielding 14 parts (63.0%) of 5-amino-*N*-[1-(2-aminoethyl)-4-piperidiny]-6-chloro-3,4-dihydro-2*H*-1-benzopyran-8-carboxamide; mp. 130°C (comp. 11).

Example 13

[0128] A mixture of 16.7 parts of compound 55; 19 parts of potassium hydroxide and 92 parts of 2-propanol was stirred for 3 hours at reflux temperature. The reaction mixture was evaporated and the residue was co-evaporated with water (2x) and then partitioned between dichloromethane, methanol and water. The aqueous layer was separated and re-extracted with dichloromethane. The combined organic layers were dried, filtered and evaporated. The residue was crystallized from water. The product was filtered off and dried, yielding 8.3 parts (65.1%) of *N*-[1-(3-aminopropyl)-4-piperidiny]-5-chloro-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxamide hemihydrate; mp. 123.1°C (comp. 71).

Example 14

[0129] To a cooled (ice-bath) mixture of 2.3 parts of compound 11 and 74 parts of trichloromethane there were added 0.86 parts of *N,N*-diethylethanamine and dropwise a solution of 0.77 parts of ethyl chloroformate in 40 parts of trichloromethane, keeping the temperature below 10°C. After stirring for 1/2 hour at room temperature, the reaction mixture was washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 95:5). The eluent of the desired fraction was evaporated and the residue was crystallized from acetonitrile. The product was filtered off and dried, yielding 1.4 parts (50.7%) of ethyl [2-[4-[[[5-amino-6-chloro-3,4-dihydro-2*H*-1-benzopyran-8-yl)carbonyl]amino]-1-piperidiny]ethyl]carbamate; mp. 160.3°C (comp. 16).

Example 15

[0130] A mixture of 3.67 parts of compound 14; 1.85 parts of 2-chloro-1H-benzimidazole, 4.7 parts of N,N-dimethylacetamide, a catalytic amount of potassium iodide and 2.10 parts of sodium carbonate was stirred for 3 hours at 120°C. After cooling, the reaction mixture was diluted with water. The product was extracted with dichloromethane (2x) and the combined extracts were washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 95:5). The eluent of the desired fraction was evaporated and the residue was converted into the ethanedioate (1:2) salt in ethanol. The product was filtered off and dried, yielding 0.56 parts (8.3%) of 4-amino-N-[1-[2-(1H-benzimidazol-2-ylamino)ethyl]-4-piperidinyl]-5-chloro-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxamide ethanedioate(1:2) hemihydrate; mp. 211.7°C (comp. 70).

Example 16

[0131] A mixture of 3.1 parts of 2-chloro-3-methylpyrazine, 4.4 parts of compound 14 and 0.79 parts of calciumoxide was stirred for 24 hours at 120°C. After cooling, the reaction mixture was partitioned between dichloromethane and NH₄OH (dil.). The aqueous layer was separated and re-extracted with dichloromethane. The combined organic layers were dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 98:2). The eluent of the desired fraction was evaporated and the residue was triturated in 2,2'-oxybispropane. The product was filtered off and dried, yielding 3.3 parts (59.9%) of 4-amino-5-chloro-2,3-dihydro-2,2-dimethyl-N-[1-[2-[(3-methyl-2-pyrazinyl)amino]ethyl]-4-piperidinyl]-7-benzofurancarboxamide; mp. 163.2°C (comp. 15).

Example 17

[0132] Through a solution of 3.5 parts of intermediate 11 in 19.8 parts of ethanol and 25 parts of water was bubbled oxirane for 1 hour at room temperature. The reaction mixture was evaporated and the residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 95:5). The eluent of the desired fraction was evaporated and the residue was crystallized from acetonitrile. The product was filtered off and dried in vacuo at 70°C, yielding 1.64 parts (40.2%) of 4-amino-5-chloro-2,3-dihydro-N-[1-(2-hydroxyethyl)-4-piperidinyl]-7-benzofurancarboxamide; mp. 185.7°C (comp. 49).

Example 18

[0133] To a mixture of 12.2 parts of compound 8 and 83 parts of water there were added 1.53 parts of sulfuric acid. After stirring for 4 1/2 hours at room temperature, the reaction mixture was poured into a mixture of NH₄OH (dil.) and ice. The product was extracted with dichloromethane and the extract was dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 97:3). The eluent of the desired fraction was evaporated and the residue was triturated in 2,2'-oxybispropane. The product was filtered off and dried, yielding 2.3 parts (40.3%) of 4-amino-5-chloro-2,3-dihydro-2,2-dimethyl-N-[1-(4-oxopentyl)-4-piperidinyl]-7-benzofurancarboxamide; mp. 119.2°C (comp. 9).

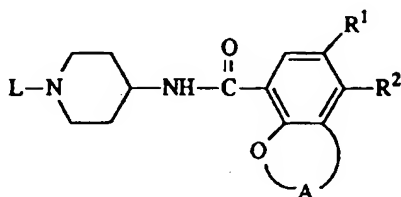
Example 19[0134]

- a) A mixture of 7.6 parts of compound 3; 5 parts of potassium acetate and 158 parts of methanol was hydrogenated at normal pressure and 50°C with 2 parts of palladium-on-charcoal catalyst 10%. After the calculated amount of hydrogen was taken up, the catalyst was filtered off and the filtrate was evaporated, yielding 6.91 parts (100%) of 4-amino-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarboxamide (comp. 75).
- b) A mixture of 8 parts of compound 75; 5 parts of 2-iodopropane, 3.1 parts of N,N-diethylethanamine and 25.8 parts of hexamethylphosphoric triamide was stirred for 20 hours at 130°C. After cooling, the reaction mixture was poured into water. The product was extracted with dichloromethane and the extract was washed with water, dried, filtered and evaporated. The residue was taken up in 2,2'-oxybispropane. After filtration, this solution was evaporated and the residue was taken up in 2-propanol. 2,2'-Oxybispropane was added to enhance crystallization. The precipitate was filtered off and dissolved in dichloromethane. This solution was washed with water, dried, filtered and evaporated. The residue was purified by column chromatography (silica gel; CH₂Cl₂/CH₃OH(NH₃) 97:3). The eluent of the desired fraction was evaporated and the residue was converted into the ethanedioate (1:1) salt. The product was filtered off and dried in vacuo at 60°C, yielding 0.3 parts (2.7%) of 2,3-dihydro-4-[(1-methylethyl)amino]-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarboxamide ethanedioate(1:1); mp.

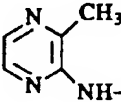
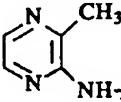
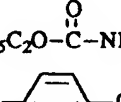
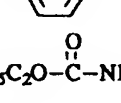
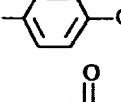
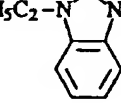
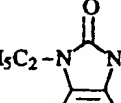
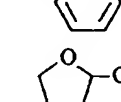
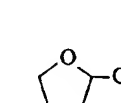
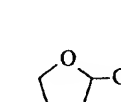

211.7°C (comp. 76).

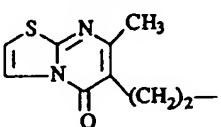
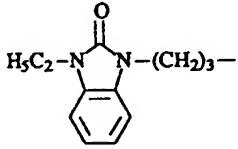
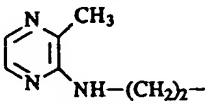
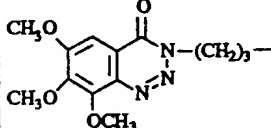
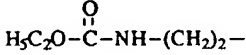
Example 20

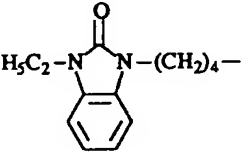
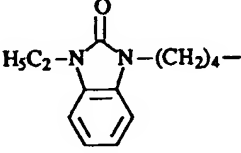
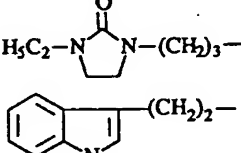
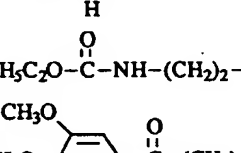
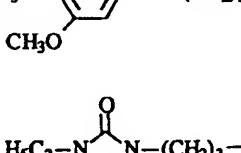
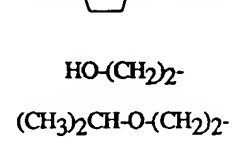
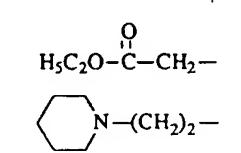
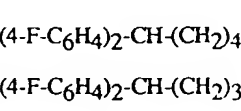

- 5 [0135] A mixture of 5 parts of compound 63 and 230 ml of HCl 3N was stirred for 1 hour at reflux temperature. After cooling, the reaction mixture was evaporated. The residue was stirred in 5 parts of water. The product was filtered off, washed with a little water and dried in vacuo at 70°C, yielding 1.7 parts (31.5%) of 4-[[[5-amino-6-chloro-3,4-dihydro-2H-1-benzopyran-8-yl)carbonyl]amino]-1-piperidinebutanoic acid monohydrochloride monohydrate; mp. 204.5°C (comp. 68).
- 10 [0136] All compounds listed in Table 2 were prepared following methods of preparation described in examples 7-20, as is indicated in the column Ex. No.




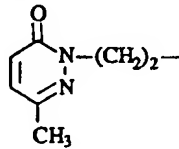
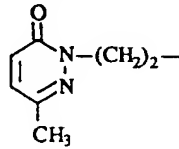

Table 2

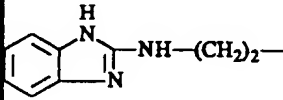
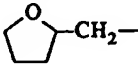
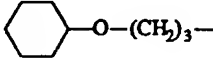
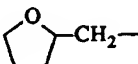
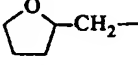
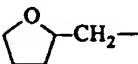
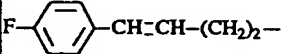
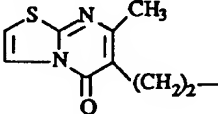
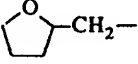
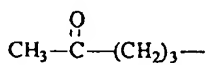
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2	8		Cl	NH ₂	-O-(CH ₂) ₃ -	211.8°C
3	7		Cl	NH ₂	-O-(CH ₂) ₂ -	175.4°C
4	10		Cl	NH ₂	-O-(CH ₂) ₂ -	139.8°C
5	18		Cl	NH ₂	-O-(CH ₂) ₂ -	137.4°C
6	10		Cl	NH ₂	-O-(CH ₂) ₃ -	111.2°C
7	18		Cl	NH ₂	-O-(CH ₂) ₃ -	104.9°C / H ₂ O
8	10		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	136.5°C
9	18		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	119.2°C

Co. No.	Ex. No.	L	R ¹	R ²	-O-A-	Physical data (mp.)
10	9	NC-CH ₂ -	Cl	NH ₂	-O-(CH ₂) ₃ -	194°C
11	12	H ₂ N-(CH ₂) ₂ -	Cl	NH ₂	-O-(CH ₂) ₃ -	130°C
12	16		Cl	NH ₂	-O-(CH ₂) ₃ -	178.8°C
13	9	NC-CH ₂ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	110°C
14	12	H ₂ N-(CH ₂) ₂ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	155°C
15	16		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	163.2°C
16	14		Cl	NH ₂	-O-(CH ₂) ₃ -	160.3°C
17	10		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	131.0°C
18	14		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	209.9°C
19	10		Cl	NH ₂	-O-(CH ₂) ₃ -	143.1°C
20	7		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	199.9°C
21	7		Cl	NH ₂	-O-(CH ₂) ₃ -	193.8°C / (COOH) ₂ 1/2 H ₂ O
22	7		Cl	NH ₂	-O-(CH ₂) ₂ -	190.2°C / (-)-(R) [α] _D ²⁰ 0.5%CH ₃ OH = -11.7°
23	7		Cl	NH ₂	-O-(CH ₂) ₂ -	191.6°C / (+)-(S) [α] _D ²⁰ 0.5%CH ₃ OH = +13.1°
24	7		Cl	NH ₂	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	175.7°C

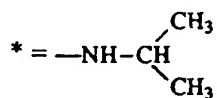
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26	12	H ₂ N-(CH ₂) ₃ -	Cl	NH ₂	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	182.8°C
27	9	NC-CH ₂ -	Cl	NH ₂	-O-(CH ₂) ₂ -	227.8°C
28	8		Cl	NH ₂	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	222°C
29	11	NC-(CH ₂) ₂ -	Cl	NH ₂	-O-(CH ₂) ₂ -	203.5°C
30	7		Cl	NH ₂	-O-(CH ₂) ₂ -	149.8°C
31	12	H ₂ N-(CH ₂) ₂ -	Cl	NH ₂	-O-(CH ₂) ₂ -	157.8°C
32	16		Cl	NH ₂	-O-(CH ₂) ₂ -	152.5°C / 1/2H ₂ O
33	9		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	205.5°C
34	11	NC-(CH ₂) ₂ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	-
35	12	H ₂ N-(CH ₂) ₃ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	132.9°C / H ₂ O
36	10	(4-F-C ₆ H ₄) ₂ -CH-(CH ₂) ₄ -	Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	195.0°C / HCl
37	10	(4-F-C ₆ H ₄) ₂ -CH-(CH ₂) ₃ -	Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	133.3°C
38	14		Cl	NH ₂	-O-(CH ₂) ₂ -	166.1°C
39	9	NC-(CH ₂) ₃ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	165.1°C
40	12	H ₂ N-(CH ₂) ₄ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	150.7°C
41	12	H ₂ N-(CH ₂) ₃ -	Cl	NH ₂	-O-(CH ₂) ₂ -	-

Co. No.	Ex. No.	L	R ¹	R ²	-O-A-	Physical data (mp.)
42	8		Cl	NH ₂	-O-(CH ₂) ₂ -	148.7°C
43	8		Cl	NH ₂	-O-(CH ₂) ₃ -	155.6°C / HCl 3/2H ₂ O
44	8		Cl	NH ₂	-O-(CH ₂) ₂ -	182.0°C
45	9		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	209.0°C
46	10		Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	229.0°C / HCl
47	9		Cl	NH ₂	-O-(CH ₂) ₂ -	202.1°C / (COOH) ₂
48	7		Cl	NH ₂	-O-(CH ₂) ₃ -	192.9°C / (COOH) ₂ H ₂ O
49	17	HO-(CH ₂) ₂ -	Cl	NH ₂	-O-(CH ₂) ₂ -	185.7°C
50	9	(CH ₃) ₂ CH-O-(CH ₂) ₂ -	Cl	NH ₂	-O-(CH ₂) ₃ -	197.9°C / (COOH) ₂ 1/2H ₂ O
51	9		Cl	NH ₂	-O-(CH ₂) ₃ -	98.8°C
52	9		Cl	NH ₂	-O-(CH ₂) ₃ -	250.5°C / 2HCl 1/2H ₂ O
53	10	(4-F-C ₆ H ₄) ₂ -CH-(CH ₂) ₄ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	169.1°C
54	10	(4-F-C ₆ H ₄) ₂ -CH-(CH ₂) ₃ -	Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	169.0°C

Co. No.	Ex. No.	L	R ¹	R ²	-O-A-	Physical data (mp.)
55	10	$\text{H}_3\text{C}_2\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}-(\text{CH}_2)_3-$	Cl	H	$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$	156.5°C / HCl H ₂ O
56	10	$(\text{CH}_3)_2\text{CH}-\text{O}-(\text{CH}_2)_2-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	237.2°C / HCl
57	10	 -N-(CH ₂) ₂ -	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	193.0°C
58	9	$\text{H}_3\text{C}_2\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	135.2°C
59	20	$\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	273.5°C / HCl 1/2H ₂ O
60	20	$\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_3-$	253.8°C / H ₂ O
61	7	 -CH ₂ -	Cl	NH ₂	$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$	147.6°C
62	10	$\text{H}_3\text{C}_2\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_3-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	220.7°C / HCl
63	10	$\text{H}_3\text{C}_2\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_3-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_3-$	186.4°C / (COOH) ₂
64	9	 -CH ₂ -CH-(CH ₂) ₂ -	Cl	NH ₂	$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$	128.1°C / (E)
65	8	 -N-(CH ₂) ₂ -	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	181.1°C
66	8	 -N-(CH ₂) ₂ -	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_3-$	90.3°C
67	20	$\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_3-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_2-$	260.3°C / HCl 1/2H ₂ O
68	20	$\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_3-$	Cl	NH ₂	$-\text{O}-(\text{CH}_2)_3-$	204.5°C / HCl H ₂ O
69	10	 -CH ₂ -CH-(CH ₂) ₂ -	Cl	H	$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$	208.9°C / HCl 3/2H ₂ O

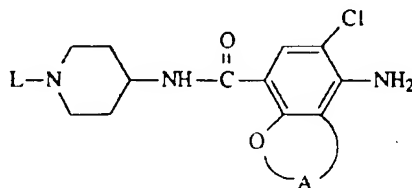
Co. No.	Ex. No.	L	R ¹	R ²	-O-A-	Physical data (mp.)
70	15		Cl	NH ₂	-O-C(CH ₃) ₂ -CH ₂ -	211.7°C / 2(COOH) ₂ 1/2H ₂ O
71	13	H ₂ N-(CH ₂) ₃ -	Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	123.1°C / 1/2H ₂ O
72	7		Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	217.0°C / HCl 1/2H ₂ O
73	7		Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	154.5°C / HCl H ₂ O
74	7		Cl	H	-O-(CH ₂) ₂ -	115°C
75	19a		H	NH ₂	-O-(CH ₂) ₂ -	-
76	19b		H	*	-O-(CH ₂) ₂ -	211.7°C / (COOH) ₂
77	9		Cl	H	-O-(CH ₂) ₂ -	134.8°C / (E)
78	8		Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	97.7°C
79	10	H ₅ C ₂ O-C(=O)-NH-(CH ₂) ₃ -	Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	122.6°C
80	13	H ₂ N-(CH ₂) ₃ -	Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	128.6°C
81	7		Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	119.0°C
82	10	(CH ₃) ₂ CH-O-(CH ₂) ₃ -	Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	215.4°C / HCl
83	9	NC-CH ₂ -	H	*	-O-C(CH ₃) ₂ -CH ₂ -	-
84	12	H ₂ N-(CH ₂) ₂ -	H	*	-O-C(CH ₃) ₂ -CH ₂ -	-
85	10		Cl	H	-O-C(CH ₃) ₂ -(CH ₂) ₂ -	208.5°C / HCl
86	13	H ₂ N-(CH ₂) ₂ -	Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	2 HCl
87	9	4-F-C ₆ H ₄ -O-(CH ₂) ₃ -	Cl	H	-O-(CH ₂) ₂ -	134.0°C
88	10	(4-F-C ₆ H ₄) ₂ CH-(CH ₂) ₂ -	Cl	H	-O-C(CH ₃) ₂ -CH ₂ -	193.4°C / HCl

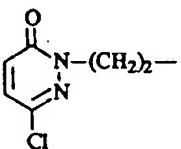
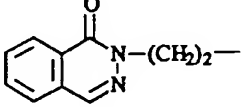
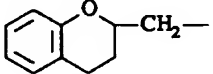
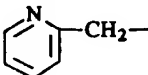
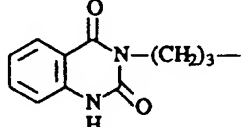
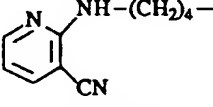
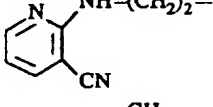
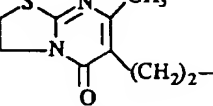
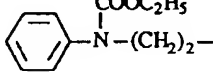
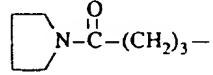
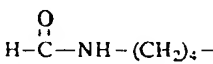
Co. No.	Ex. No.	L	R ¹	R ²	-O-A-	Physical data (mp.)
89	7		Cl	H	-O-(CH ₂) ₂ -	141.5°C
90	7		Cl	NH ₂	-O-(CH ₂) ₃ -	131.8°C
91	17	HO-(CH ₂) ₂ -	Cl	NH ₂	-O-(CH ₂) ₃ -	126.0°C
92	10		Cl	H	-O-(CH ₂) ₂ -	104.5°C
93	7		Cl	H	-O-(CH ₂) ₂ -	112.8°C
94	9	NC-CH ₂ -	Cl	H	-O-(CH ₂) ₂ -	208.6°C
95	8		Cl	H	-O-(CH ₂) ₂ -	117.0°C
96	18		Cl	H	-O-(CH ₂) ₂ -	89.1°C
97	7		Cl	NH ₂	-O-(CH ₂) ₃ -	126.5°C / (-)-(R) [α] _D ²⁰ 1%CH ₃ OH = -11.8°

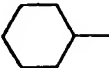
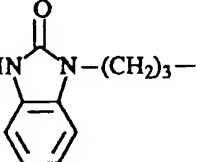
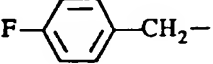
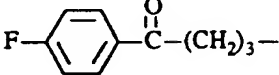
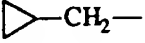
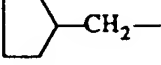


[0137] The compounds listed in Table 3 prepared according to similar procedures as described in any of the preceding examples (7-20).

Table 3



Co. No.	L	-O-A-
98		-O-(CH ₂) ₃ -
99		-O-(CH ₂) ₃ -
100		-O-(CH ₂) ₃ -
101		-O-(CH ₂) ₃ -
102		-O-(CH ₂) ₃ -
103		-O-(CH ₂) ₃ -
104		-O-(CH ₂) ₃ -
105		-O-(CH ₂) ₃ -
106		-O-(CH ₂) ₃ -
107	CH ₃ O-(CH ₂) ₃ -	-O-(CH ₂) ₃ -
108		-O-(CH ₂) ₃ -
109	(CH ₃) ₂ CH-NH-(CH ₂) ₂ -	-O-(CH ₂) ₃ -
110	(CH ₃) ₂ CH-NH-(CH ₂) ₄ -	-O-(CH ₂) ₃ -
111		-O-(CH ₂) ₃ -

Co. No.	L	-O-A-
112	$\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}-(\text{CH}_2)_2-$	$-\text{O}-(\text{CH}_2)_3-$
113	$\text{H}_3\text{C}_2\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}-(\text{CH}_2)_4-$	$-\text{O}-(\text{CH}_2)_3-$
114	$\text{H}_3\text{C}_2\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}-(\text{CH}_2)_2-$	$-\text{O}-(\text{CH}_2)_3-$
115		$-\text{O}-(\text{CH}_2)_3-$
116	$\text{HO}-(\text{CH}_2)_2-\text{O}-(\text{CH}_2)_2-$	$-\text{O}-(\text{CH}_2)_3-$
117		$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$
118		$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$
119		$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$
120	$\text{CH}_2=\text{CH}-\text{CH}_2-$	$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$
121		$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$
122		$-\text{O}-\text{C}(\text{CH}_3)_2-\text{CH}_2-$

C. Pharmacological examples

[0138] The useful gastrointestinal motility stimulating properties of the compounds of the present invention and in particular their capability to enhance the contractility of the colon can be demonstrated in the following test.

Example 21

Colon ascendens induced contractions.

[0139] The experiment was conducted according to similar procedures as described in The Journal of Pharmacology and Experimental Therapeutics, 234, 776-783 (1985). Colon segments, 4.5 cm long, were vertically suspended with a preload of 2 g in 100 ml of a De Jalon solution [KCl 5.6 mM; $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ 0.54 mM; NaHCO_3 5.9 mM; NaCl 154.1 mM; glucose 2.8 mM] at 37.5°C and gassed with a mixture of 95% O_2 and 5% CO_2 . Contractions were measured isotonically with a HP 7 DCDT-1000, JSID Displacement Transducer Control Unit.

After a stabilization period of about 20 minutes, 3.4×10^{-6} M methacholine was given at a time interval of 15 minutes. When reproducible contractions were obtained, the test compound was administered to the bathing solution. The com-

pound effect was followed for 10 minutes and expressed relative to the maximal concentrations induced by 3.4×10^{-6} M methacholine. The % effect for a representative number of compounds of formula (I) is depicted hereinbelow in Table 4

Table 4

Co. No.	Dose $3 \cdot 10^{-6}$ M	Dose $3 \cdot 10^{-7}$ M
2	-	28
3	52	20
16	-	30
17	-	30
19	-	35
20	-	41
22	46	29
23	48	26
30	-	36
65	-	27
81	-	27

D. Composition Examples

[0140] The following formulations exemplify typical pharmaceutical compositions in dosage unit form suitable for systemic or topical administration to warm-blooded animals in accordance with the present invention.

[0141] "Active ingredient" (A.I.) as used throughout these examples relates to a compound of formula (I), a pharmaceutically acceptable acid addition salt or a stereochemically isomeric form thereof.

Example 22: Oral solutions

[0142] 9 g of methyl 4-hydroxybenzoate and 1 g of propyl 4-hydroxybenzoate are dissolved in 4 l of boiling purified water. In 3 l of this solution are dissolved first 10 g of 2,3-dihydroxybutanedioic acid and thereafter 20 g of the A.I. The latter solution is combined with the remaining part of the former solution and 12 l of 1,2,3-propanetriol and 3 l of sorbitol 70% solution are added thereto. 40 g of sodium saccharin are dissolved in 0.5 l of water and 2 ml of raspberry and 2 ml of gooseberry essence are added. The latter solution is combined with the former, water is added q.s. to a volume of 20 l providing an oral solution comprising 5 mg of the A.I. per teaspoonful (5 ml). The resulting solution is filled in suitable containers.

Example 23: Capsules

[0143] 20 g of the A.I., 6 g sodium lauryl sulfate, 56 g starch, 56 g lactose, 0.8 g colloidal silicon dioxide, and 1.2 g magnesium stearate are vigorously stirred together. The resulting mixture is subsequently filled into 1000 suitable hardened gelatin capsules, each comprising 20 mg of the A.I..

Example 24: Film-coated tablets

[0144]

Preparation of tablet core

[0145] A mixture of 100 g of the A.I., 570 g lactose and 200 g starch is mixed well and thereafter humidified with a solution of 5 g sodium dodecyl sulfate and 10 g polyvinylpyrrolidone (Kollidon-K 90®) in about 200 ml of water. The wet powder mixture is sieved, dried and sieved again. Then there are added 100 g microcrystalline cellulose (Avicel®) and

15 g hydrogenated vegetable oil (Sterotex[®]). The whole is mixed well and compressed into tablets, giving 10.000 tablets, each comprising 10 mg of the active ingredient.

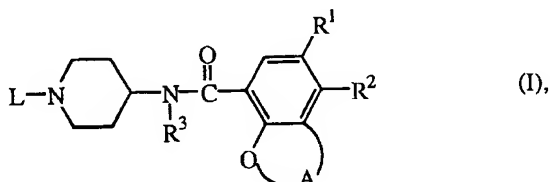
Coating

[0146] To a solution of 10 g methyl cellulose (Methocel 60 HG[®]) in 75 ml of denaturated ethanol there is added a solution of 5 g of ethyl cellulose (Ethocel 22 cps[®]) in 150 ml of dichloromethane. Then there are added 75 ml of dichloromethane and 2.5 ml 1,2,3-propanetriol. 10 g of polyethylene glycol is molten and dissolved in 75 ml of dichloromethane. The latter solution is added to the former and then there are added 2.5 g of magnesium octadecanoate, 5 g of polyvinylpyrrolidone and 30 ml of concentrated colour suspension (Opaspray K-1-2109[®]) and the whole is homogenated. The tablet cores are coated with the thus obtained mixture in a coating apparatus.

Claims

Claims for the following Contracting States : DE, GB, FR, IT, NL, SE, LI, CH, BE, AT, LU, DK

1. A compound having the formula :



a N-oxide form, a salt or a stereochemically isomeric form thereof, wherein :

A is a radical of formula



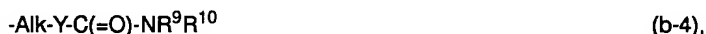
wherein one or two hydrogen atoms in said radicals (a-1) to (a-3) may be replaced by a C₁₋₆alkyl radical;

R¹ is hydrogen or halo;

R² is hydrogen, amino, mono or di(C₁₋₆alkyl)amino or C₁₋₆alkylcarbonylamino;

R³ is hydrogen or C₁₋₆alkyl;

L is C₃₋₆cycloalkyl, C₅₋₆cycloalkanone, C₃₋₆alkenyl optionally substituted with aryl, or L is a radical of formula



wherein each Alk is C₁₋₆alkanediyl; and

R⁴ is hydrogen, cyano, C₁₋₆alkylsulfonylamino, C₃₋₆cycloalkyl, C₅₋₆cycloalkanone, aryl, di(aryl)methyl or Het;

R⁵ is hydrogen, C₁₋₆alkyl, hydroxyC₁₋₆alkyl, C₃₋₆cycloalkyl, aryl or Het;

X is O, S, SO₂ or NR⁶; said R⁶ being hydrogen, C₁₋₆alkyl or aryl;

R⁷ is hydrogen, C₁₋₆alkyl, C₃₋₆cycloalkyl, aryl, arylC₁₋₆alkyl, di(aryl)methyl, C₁₋₆alkyloxy or hydroxy;

Y is NR⁸ or a direct bond; said R⁸ being hydrogen, C₁₋₆alkyl or aryl;

R⁹ and R¹⁰ each independently are hydrogen, C₁₋₆alkyl, C₃₋₆cycloalkyl, aryl or arylC₁₋₆alkyl, or R⁹ and R¹⁰ combined with the nitrogen atom bearing R⁹ and R¹⁰ may form a pyrrolidinyl or piperidinyl ring both being optionally substituted with C₁₋₆alkyl, amino or mono or di(C₁₋₆alkyl)amino, or said R⁹ and R¹⁰ combined with the nitrogen bearing R⁹ and R¹⁰ may form a piperazinyl or 4-morpholinyl radical both being optionally substituted with C₁₋₆alkyl;

each aryl being unsubstituted phenyl or phenyl substituted with 1,2 or 3 substituents each independently selected from halo, hydroxy, C₁₋₆alkyl, C₁₋₆alkyloxy, amino-sulfonyl, C₁₋₆alkylcarbonyl, nitro, trifluoromethyl, amino or aminocarbonyl; and

each Het being a five- or six-membered heterocyclic ring containing 1,2,3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that no more than 2 oxygen and/or sulfur atoms are present, said five- or six-membered ring being optionally condensed with a five- or six-membered carboxylic or heterocyclic ring also containing 1,2,3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that the latter ring does not contain more than 2 oxygen and/or sulfur atoms and that the total number of heteroatoms in the bicyclic ring system is less than 6; when Het is a monocyclic ring system it may optionally be substituted with up to 4 substituents; when Het is a bicyclic ringsystem it may optionally be substituted with up to 6 substituents; said substituents being selected from the group consisting of halo, hydroxy, cyano, trifluoromethyl, C₁₋₆alkyl, arylC₁₋₆alkyl, aryl, C₁₋₆alkyloxy, C₁₋₆alkyloxyC₁₋₆alkyl, hydroxyC₁₋₆alkyl, C₁₋₆alkylthio, mercapto, nitro, amino, mono and di(C₁₋₆alkyl)amino, arylC₁₋₆alkylamino, aminocarbonyl, mono and di(C₁₋₆alkyl)aminocarbonyl, C₁₋₆alkyloxy carbonyl, arylC₁₋₆alkyloxy carbonyl, a bivalent radical =O and =S; provided that when R⁵ is Het, Het is connected to X on a carbon atom.

2. A compound according to claim 1 wherein A is a radical of formula (a-1) or (a-2) wherein the carbon atom adjacent to the oxygen atom is optionally substituted with one or two C₁₋₄alkyl substituents; R¹ is hydrogen or halo; R² is hydrogen, amino or C₁₋₆alkylamino; R³ is hydrogen; and

L is C₃₋₆cycloalkyl or C₃₋₆alkenyl optionally substituted with aryl; or

L is a radical of formula (b-1) wherein R⁴ is hydrogen, cyano, C₃₋₆cycloalkyl, C₅₋₆cycloalkanone, aryl, di(aryl)methyl or Het; or

L is a radical of formula (b-2) wherein X is O, S or NH and R⁵ is hydrogen, C₁₋₄alkyl, C₃₋₆cycloalkyl, aryl or Het; or

L is a radical of formula (b-3) wherein Y is NR⁸ or a direct bond, R⁸ is hydrogen or aryl and R⁷ is hydrogen, C₁₋₄alkyl, aryl, C₁₋₄alkyloxy or hydroxy; or

L is a radical of formula (b-4) wherein Y is NH or a direct bond and R⁹ and R¹⁰ each independently are hydrogen or C₁₋₄alkyl, or R⁹ and R¹⁰ combined with the nitrogen bearing said R⁹ and R¹⁰ may form a pyrrolidinyl or piperidinyl radical.

3. A compound according to claim 2 wherein

L is C₅₋₆cycloalkyl or C₃₋₆alkenyl optionally substituted with aryl; or

L is a radical of formula (b-1) wherein Alk is C₁₋₄alkanediyl and R⁴ is cyano, C₃₋₆cycloalkyl, diarylmethyl or Het; or

L is a radical of formula (b-2) wherein Alk is C₁₋₄alkanediyl, X is O or NH and R⁵ is hydrogen, C₁₋₄alkyl, C₃₋₆cycloalkyl, aryl or Het; or

L is a radical of formula (b-3) wherein Alk is C₁₋₄alkanediyl, Y is NH or a direct bond and R⁷ is C₁₋₄alkyl, aryl, C₁₋₄alkyloxy or hydroxy.

4. A compound according to claim 3 wherein Het is tetrahydrofuranyl optionally substituted with C₁₋₄alkyl; 1,3-dioxolanyl optionally substituted with C₁₋₄alkyl; 3,4-dihydro-1(2H)-benzopyranyl; pyrrolidinyl; piperidinyl; pyridinyl optionally substituted with cyano; pyrazinyl optionally substituted with C₁₋₄alkyl; benzimidazolyl; indolyl; 2,3-dihydro-2-oxo-1H-benzimidazolyl optionally substituted with C₁₋₄alkyl; 2-oxo-1-imidazolidinyl optionally substituted with C₁₋₄alkyl; 3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-yl optionally substituted with three C₁₋₄alkyloxy groups; 1-oxo-2(1H)-phthalazinyl; 2,3-dihydro-5-oxo-5H-thiazolo-[3,2-a]pyrimidin-6-yl optionally substituted with C₁₋₄alkyl; 5-oxo-5H-thiazolo-[3,2-a]pyrimidin-6-yl optionally substituted with C₁₋₄alkyl; 1,6-dihydro-6-oxo-1-pyridazinyl optionally substituted with C₁₋₄alkyl or halo; and 1,2,3,4-tetrahydro-2,4 dioxo-3-quinazolinyl.

5. A compound according to claim 4 wherein R¹ is hydrogen or chloro; R² is hydrogen, amino or (1-methylethyl)amino; R³ is hydrogen; and L is a radical of formula (b-1) wherein R⁴ is cyano, cyclopentyl, tetrahydrofuranyl, piperidinyl,

7-methyl-5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl; 3-ethyl-2,3-dihydro-2-oxo-1H-benzimidazolyl; 1,6-dihydro-3-methyl-6-oxo-1-pyridazinyl; or

L is a radical of formula (b-2) wherein X is O or NH and R⁵ is H or 4-fluorophenyl; or

L is a radical of formula (b-3) wherein Y is NH or a direct bond and R⁷ is methyl, ethoxy or 3,4,5-trimethoxyphenyl.

6. A compound according to claim 1 selected from the group consisting of 5-amino-6-chloro-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidiny]-2H-1-benzopyran-8-carboxamide;

(-)-(R)-5-amino-6-chloro-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidiny]-2H-1-benzopyran-8-carboxamide;

(-)-(R)-4-amino-5-chloro-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidiny]-7-benzofurancarboxamide; and

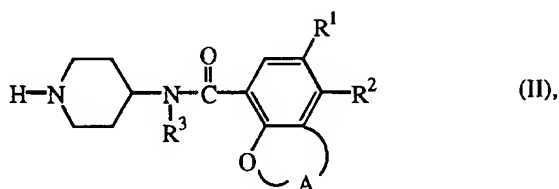
4-amino-5-chloro-N-[1-(3-cyanopropyl)-4-piperidiny]-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxamide.

7. A pharmaceutical composition comprising an inert carrier and as active ingredient a gastrointestinal motility stimulating amount of a compound as claimed in any of claims 1 to 6.

8. A method of preparing a pharmaceutical composition as claimed in claim 6, characterized in that a therapeutically effective amount of a compound as claimed in any of claims 1 to 6 is intimately mixed with a pharmaceutical carrier.

9. A compound as claimed in any of claims 1 to 6 for use as a medicine.

10. A compound having the formula :



a N-oxide form, a salt or a stereochemically isomeric form thereof, wherein

A is a radical of formula



wherein one or two hydrogen atoms in said radicals (a-1) to (a-3) may be replaced by a C₁₋₆alkyl radical;

R¹ is hydrogen or halo;

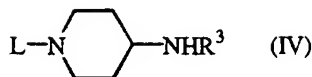
R² is hydrogen, amino, mono or di(C₁₋₆alkyl)amino or C₁₋₆alkylcarbonylamino; and

R³ is hydrogen or C₁₋₆alkyl.

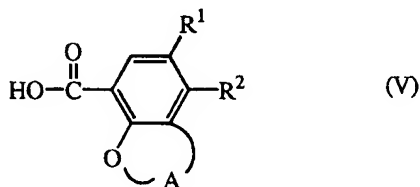
11. A process for preparing a compound of formula (I) as claimed in any of claims 1 to 6, characterized by :

a) N-alkylating a piperidine of formula H-D (II) with an intermediate of formula L-W (III), wherein W is a reactive leaving group and L is as defined under formula (I), in a reaction-inert solvent, optionally in the presence of a base and/or an iodide salt;

b) reacting a piperidinamine of formula



wherein R^3 and L are as defined under formula (I) with a carboxylic acid of formula

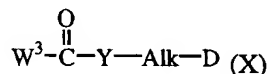


or a functional derivative thereof, wherein R^1 , R^2 and A are as defined under formula (I) in a reaction-inert solvent, optionally in the presence of a reagent capable of forming amides;

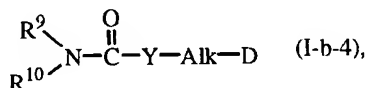
c) reductive N-alkylating an intermediate of formula H-D (II) with a ketone or aldehyde of formula $\text{L}'=\text{O}$ (VI), wherein $\text{L}'=\text{O}$ is a compound of formula L-H wherein two geminal hydrogen atoms in the C_{1-6} alkanediyl or C_{3-6} cycloalkanediyl moiety are replaced by $=\text{O}$, in a reaction-inert solvent;

d) reacting an intermediate of formula $\text{R}^{5-a}\text{-W}^1$ (VII) or $\text{R}^{5-a}\text{-X-H}$ (VIII) wherein R^{5-a} is aryl or Het, with a piperidine of formula HX-Alk-D (I-b-2-a) or $\text{W}^2\text{-Alk-D}$, wherein Alk and X are as defined under formula (I) and W^1 and W^2 are both reactive leaving groups in a reaction-inert solvent, thus yielding a compound of formula $\text{R}^{5-a}\text{-X-Alk-D}$ (I-b-2-b);

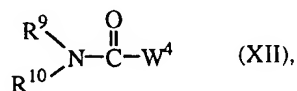
e) reacting an amine of formula $\text{R}^9\text{-NH-R}^{10}$ (XI) wherein R^9 and R^{10} are as defined under formula (I) with an intermediate of formula



wherein W^3 is a reactive leaving group and Y and Alk are as defined under formula (I), in a reaction-inert solvent, thus yielding a compound of formula

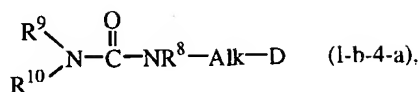


f) reacting an amide of formula



wherein R^9 and R^{10} are as defined under formula (I) and W^4 is a reactive leaving group, with an amine of formula $\text{H-NR}^8\text{-Alk-D}$ (XIII), wherein R^8 and Alk are as defined under formula (I); in a reaction-inert solvent, thus

yielding a compound of formula



g) reacting a carboxylic acid of formula $\text{R}^7\text{-COOH}$ (XIV) wherein R^7 is as defined under formula (1) with an amine of formula $\text{HNR}^8\text{-Alk-D}$ (XIII) wherein R^8 and Alk are as defined under formula (I) in a reaction-inert solvent thus yielding a compound of formula

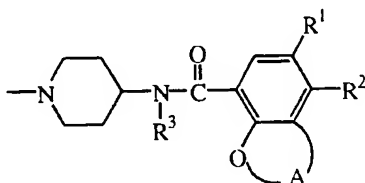


h) reacting a piperidine of formula H-D (II) with an intermediate of formula $\text{R}^{4\text{-a}}\text{-C}_{2-6}\text{alkenediyl-H}$ (XV), wherein $\text{R}^{4\text{-a}}$ is cyano, aryl or Het in a reaction-inert solvent, thus yielding a compound of formula $\text{R}^{4\text{-a}}\text{-C}_{2-6}\text{alkenediyl-D}$ (I-b-1);

i) reacting a piperidine of formula H-D (II) with an epoxide



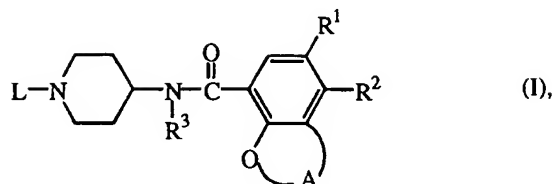
wherein $\text{R}^{5\text{-b}}$ is H or $\text{C}_{1-6}\text{alkyl}$ in a reaction-inert solvent, thus yielding a compound of formula $\text{HO-CH(R}^{5\text{-b}}\text{)-CH}_2\text{-D}$ (I-b-2-c);
and D represents the radical



wherein R^1 , R^2 , R^3 and A are as defined under formula (I) or optionally converting the compounds of formula (I) into each other following art-known functional group transformation procedures, and, if desired, converting a compound of formula (I) into a therapeutically active non-toxic salt by treatment with an appropriate acid or conversely, converting the salt form into the free base form with alkali; and/or preparing N-oxide forms and stereochemically isomeric forms thereof.

Claims for the following Contracting States : ES, GR

1. A process for preparing a compound having the formula :



10 a N-oxide form, a salt or a stereochemically isomeric form thereof, wherein :

A is a radical of formula



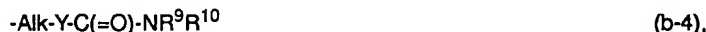
wherein one or two hydrogen atoms in said radicals (a-1) to (a-3) may be replaced by a C_{1-6} alkyl radical;

R^1 is hydrogen or halo;

R^2 is hydrogen, amino, mono or di(C_{1-6} alkyl)amino or C_{1-6} alkylcarbonylamino;

R^3 is hydrogen or C_{1-6} alkyl;

25 L is C_{3-6} cycloalkyl, C_{5-6} cycloalkanone, C_{3-6} alkenyl optionally substituted with aryl, or L is a radical of formula



35 wherein each Alk is C_{1-6} alkanediyl; and

R^4 is hydrogen, cyano, C_{1-6} alkylsulfonylamino, C_{3-6} cycloalkyl, C_{5-6} cycloalkanone, aryl, di(aryl)methyl or Het;

R^5 is hydrogen, C_{1-6} alkyl, hydroxy C_{1-6} alkyl, C_{3-6} cycloalkyl, aryl or Het;

X is O, S, SO_2 or NR^6 ; said R^6 being hydrogen, C_{1-6} alkyl or aryl;

R^7 is hydrogen, C_{1-6} alkyl, C_{3-6} cycloalkyl, aryl, aryl C_{1-6} alkyl, di(aryl)methyl, C_{1-6} alkyloxy or hydroxy;

40 Y is NR^8 or a direct bond; said R^8 being hydrogen, C_{1-6} alkyl or aryl;

R^9 and R^{10} each independently are hydrogen, C_{1-6} alkyl, C_{3-6} cycloalkyl, aryl or aryl C_{1-6} alkyl, or R^9 and R^{10} combined with the nitrogen atom bearing R^9 and R^{10} may form a pyrrolidinyl or piperidinyl ring both being optionally substituted with C_{1-6} alkyl; amino or mono or di(C_{1-6} alkyl)amino, or said R^9 and R^{10} combined with the nitrogen bearing R^9 and R^{10} may form a piperazinyl or 4-morpholinyl radical both being optionally substituted with C_{1-6} alkyl;

45 each aryl being unsubstituted phenyl or phenyl substituted with 1,2 or 3 substituents each independently selected from halo, hydroxy, C_{1-6} alkyl, C_{1-6} alkyloxy, amino-sulfonyl, C_{1-6} alkylcarbonyl, nitro, trifluoromethyl, amino or aminocarbonyl; and

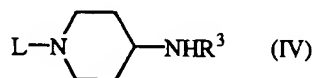
50 each Het being a five- or six-membered heterocyclic ring containing 1,2,3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that no more than 2 oxygen and/or sulfur atoms are present, said five- or six-membered ring being optionally condensed with a five- or six-membered carboxylic or heterocyclic ring also containing 1,2,3 or 4 heteroatoms selected from oxygen, sulfur and nitrogen, provided that the latter ring does not contain more than 2 oxygen and/or sulfur atoms and that the total number of heteroatoms in the bicyclic ring system is less than 6; when Het is a monocyclic ring system it may optionally be substituted with up to 4 substituents; when Het is a bicyclic ringsystem it may optionally be substituted with up to 6 substituents; said substituents being selected from the group consisting of halo, hydroxy, cyano, trifluoromethyl, C_{1-6} alkyl, aryl C_{1-6} alkyl, aryl, C_{1-6} alkyloxy, C_{1-6} alkyloxy C_{1-6} alkyl, hydroxy C_{1-6} alkyl, C_{1-6} alkylthio, mercapto, nitro, amino, mono and di(C_{1-6} alkyl)amino, aryl C_{1-6} alkylamino, aminocarbonyl, mono and di(C_{1-6} alkyl)aminocarbonyl, C_{1-}

alkyloxycarbonyl, arylC₁₋₆alkyloxycarbonyl, a bivalent radical =O and =S; provided that when R⁵ is Het, Het is connected to X on a carbon atom;

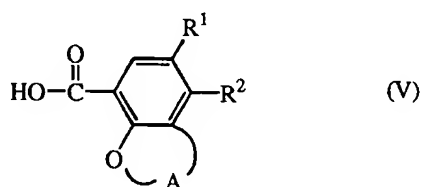
characterized by :

a) N-alkylating a piperidine of formula H-D (II) with an intermediate of formula L-W (III), wherein W is a reactive leaving group and L is as defined under formula (I), in a reaction-inert solvent, optionally in the presence of a base and/or an iodide salt;

b) reacting a piperidinamine of formula



wherein R³ and L are as defined under formula (I) with a carboxylic acid of formula

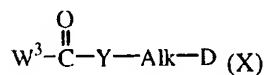


or a functional derivative thereof wherein R¹, R² and A are as defined under formula (I) in a reaction-inert solvent, optionally in the presence of a reagent capable of forming amides;

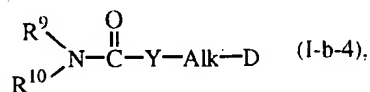
c) reductive N-alkylating an intermediate of formula H-D (II) with a ketone or aldehyde of formula L'=O (VI), wherein L'=O is a compound of formula L-H wherein two geminal hydrogen atoms in the C₁₋₆alkanediyl or C₃₋₆cycloalkanediyl moiety are replaced by =O, in a reaction-inert solvent;

d) reacting an intermediate of formula R^{5-a}.W¹ (VII) or R^{5-a}.X-H (VIII) wherein R^{5-a} is aryl or Het, with a piperidine of formula HX-Alk-D (I-b-2-a) or W².Alk-D, wherein Alk and X are as defined under formula (I) and W¹ and W² are both reactive leaving groups in a reaction-inert solvent, thus yielding a compound of formula R^{5-a}.X-Alk-D (I-b-2-b);

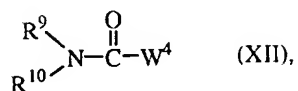
e) reacting an amine of formula R⁹.NH-R¹⁰ (XI) wherein R⁹ and R¹⁰ are as defined under formula (I) with an intermediate of formula



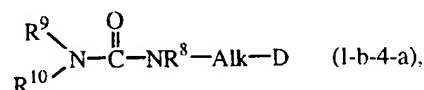
wherein W³ is a reactive leaving group and Y and Alk are as defined under formula (I), in a reaction-inert solvent, thus yielding a compound of formula



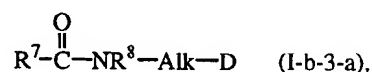
f) reacting an amide of formula



wherein R^9 and R^{10} are as defined under formula (I) and W^4 is a reactive leaving group, with an amine of formula $\text{H}-\text{NR}^8-\text{Alk}-\text{D}$ (XIII), wherein R^8 and Alk are as defined under formula (I), in a reaction-inert solvent, thus yielding a compound of formula



g) reacting a carboxylic acid of formula R^7-COOH (XIV) wherein R^7 is as defined under formula (I) with an amine of formula $\text{HNR}^8-\text{Alk}-\text{D}$ (XIII) wherein R^8 and Alk are as defined under formula (I) in a reaction-inert solvent thus yielding a compound of formula

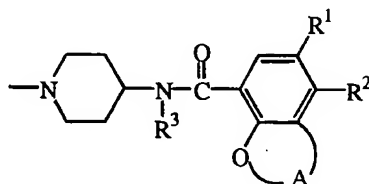


h) reacting a piperidine of formula $\text{H}-\text{D}$ (II) with an intermediate of formula $\text{R}^{4-a}-\text{C}_{2-6}\text{alkenediyl}-\text{H}$ (XV), wherein R^{4-a} is cyano, aryl or Het in a reaction-inert solvent, thus yielding a compound of formula $\text{R}^{4-a}-\text{C}_{2-6}\text{alkenediyl}-\text{D}$ (I-b-1);

i) reacting a piperidine of formula $\text{H}-\text{D}$ (II) with an epoxide



wherein R^{5-b} is H or $\text{C}_{1-6}\text{alkyl}$ in a reaction-inert solvent, thus yielding a compound of formula $\text{HO}-\text{CH}(\text{R}^{5-b})-\text{CH}_2-\text{D}$ (I-b-2-c); and D represents the radical



wherein R^1 , R^2 , R^3 and A are as defined under formula (I) or optionally converting the compounds of formula (I) into each other following art-known functional group transformation procedures, and, if desired, converting a compound of formula (I) into a therapeutically active non-toxic salt by treatment with an appropriate acid or conversely, converting the salt form into the free base form with alkali; and/or preparing

N-oxide forms and stereochemically isomeric forms thereof.

2. A process according to claim 1, preparing a compound of formula (I), wherein A is a radical of formula (a-1) or (a-2) wherein the carbon atom adjacent to the oxygen atom is optionally substituted with one or two C₁₋₄alkyl substituents; R¹ is hydrogen or halo; R² is hydrogen, amino or C₁₋₆alkylamino; R³ is hydrogen; and L is C₃₋₆cycloalkyl or C₃₋₆alkenyl optionally substituted with aryl; or L is a radical of formula (b-1) wherein R⁴ is hydrogen, cyano, C₃₋₆cycloalkyl, C₅₋₆cycloalkanone, aryl, di(aryl)methyl or Het; or L is a radical of formula (b-2) wherein X is O, S or NH and R⁵ is hydrogen, C₁₋₄alkyl, C₃₋₆cycloalkyl, aryl or Het; or L is a radical of formula (b-3) wherein Y is NR⁸ or a direct bond, R⁸ is hydrogen or aryl and R⁷ is hydrogen, C₁₋₄alkyl, aryl, C₁₋₄alkyloxy or hydroxy; or L is a radical of formula (b-4) wherein Y is NH or a direct bond and R⁹ and R¹⁰ each independently are hydrogen or C₁₋₄alkyl, or R⁹ and R¹⁰ combined with the nitrogen bearing said R⁹ and R¹⁰ may form a pyrrolidinyl or piperidinyl radical.

3. A process according to claim 1, preparing a compound of formula (I), wherein L is C₅₋₆cycloalkyl or C₃₋₆alkenyl optionally substituted with aryl; or L is a radical of formula (b-1) wherein Alk is C₁₋₄alkanediyl and R⁴ is cyano, C₃₋₆cycloalkyl, diarylmethyl or Het; or L is a radical of formula (b-2) wherein Alk is C₁₋₄alkanediyl, X is O or NH and R⁵ is hydrogen, C₁₋₄alkyl, C₃₋₆cycloalkyl, aryl or Het; or L is a radical of formula (b-3) wherein Alk is C₁₋₄alkanediyl, Y is NH or a direct bond and R⁷ is C₁₋₄alkyl, aryl, C₁₋₄alkyloxy or hydroxy.

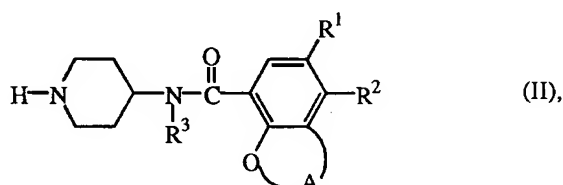
4. A process according to claim 1 for preparing a compound of formula (I), selected from the group consisting of 5-amino-6-chloro-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carboxamide;

(-)-(R)-5-amino-6-chloro-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carboxamide;

(-)-(R)-4-amino-5-chloro-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarboxamide; and

4-amino-5-chloro-N-[1-(3-cyanopropyl)-4-piperidinyl]-2,3-dihydro-2,2-dimethyl-7-benzofurancarboxamide.

5. A process for preparing a compound of formula



a N-oxide form, a salt or a stereochemically isomeric form thereof, wherein

A is a radical of formula

-CH₂-CH₂- (a-1),

-CH₂-CH₂-CH₂- (a-2), or

-CH₂-CH₂-CH₂-CH₂- (a-3),

wherein one or two hydrogen atoms in said radicals (a-1) to (a-3) may be replaced by a C₁₋₆alkyl radical;

R¹ is hydrogen or halo;

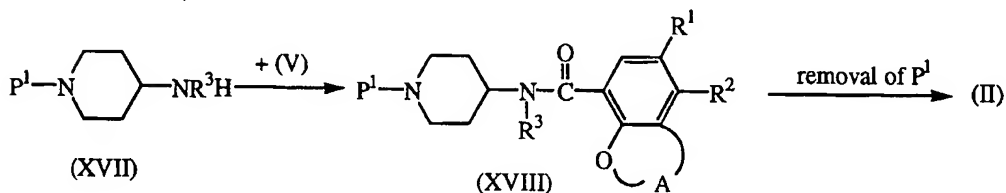
R² is hydrogen, amino, mono or di(C₁₋₆alkyl)amino or C₁₋₆alkylcarbonylamino; and

R³ is hydrogen or C₁₋₆alkyl;

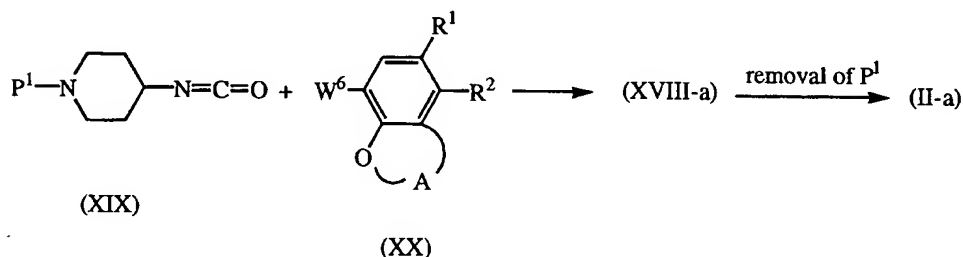
characterized by

a) reacting an appropriately substituted piperidine of formula (XVII), wherein R³ is hydrogen or C₁₋₆alkyl and P¹ represents a suitable protective group which is readily removable by hydrogenation or hydrolysis, such as, for example, phenylmethyl, or a hydrolyzable groups, such as C₁₋₄alkyloxycarbonyl, e.g. ethoxycarbonyl, benzyloxycarbonyl, with a reagent of formula (V) or a functional derivative thereof, and subse-

quently removing of the protective group P^1 in the thus obtained intermediate (XVIII) following art-known procedures, e.g. by hydrolysis in an acidic or an alkaline medium or by catalytic hydrogenation, depending upon the nature of P^1 ;



b) reacting an isocyanate of formula (XIX) with an intermediate of formula (XX), wherein W^5 is an alkali metal, e.g. lithium, sodium and the like; or halo magnesium e.g. magnesium bromide or magnesium chloride, yielding an intermediate of formula (XVIII-a) wherein R^3 is H, said intermediate being represented by formula (XVIII-a); and deprotecting as described hereinabove to yield the intermediates of formula (II-a), wherein R^3 is hydrogen



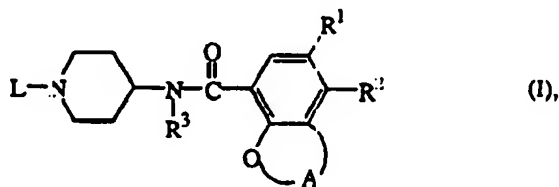
or optionally converting the compounds of formula (I) into each other following art-known functional group transformation procedures, and, if desired, converting a compound of formula (I) into a therapeutically active non-toxic salt by treatment with an appropriate acid or conversely, converting the salt form into the free base form with alkali; and/or preparing N -oxide forms and stereochemically isomeric forms thereof.

6. A process of preparing a pharmaceutical composition comprising an inert carrier and as active ingredient a gastrointestinal motility stimulating amount of a compound of formula (I);
characterized in that a therapeutically effective amount of a compound of formula (I) is intimately mixed with a pharmaceutical carrier.

Patentansprüche

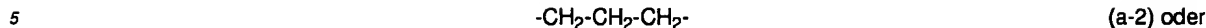
Patentansprüche für folgende Vertragsstaaten : DE, GB, FR, IT, NL, SE, LI, CH, BE, AT, LU, DK

1. Verbindung der Formel:



eine N -Oxidform, ein Salz oder eine stereochemisch isomere Form davon, wobei:

A für einen Rest der Formel



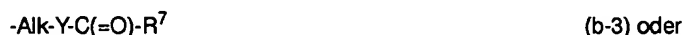
steht, wobei ein oder zwei Wasserstoffatome in den Resten (a-1) bis (a-3) durch einen C₁₋₆-Alkyl-Rest ersetzt sein können;

R¹ für Wasserstoff oder Halogen steht;

R² für Wasserstoff, Amino, Mono- oder Di(C₁₋₆-alkyl)amino oder C₁₋₆-Alkylcarbonylamino steht;

R³ für Wasserstoff oder C₁₋₆-Alkyl steht;

L für C₃₋₆-Cycloalkyl, C₅₋₆-Cycloalkanon, C₃₋₆-Alkenyl, welches gegebenenfalls durch Aryl substituiert ist, steht oder L für einen Rest der Formel



steht, wobei Alk jeweils für C₁₋₆-Alkandyl steht; und

R⁴ für Wasserstoff, Cyano, C₁₋₆-Alkylsulfonylamino, C₃₋₆-Cycloalkyl, C₅₋₆-Cycloalkanon, Aryl, Di(aryl)methyl oder Het steht;

R⁵ für Wasserstoff, C₁₋₆-Alkyl, Hydroxy-C₁₋₆-alkyl, C₃₋₆-Cycloalkyl, Aryl oder Het steht;

X für O, S, SO₂ oder NR⁶ steht; wobei R⁶ Wasserstoff, C₁₋₆-Alkyl oder Aryl darstellt;

R⁷ für Wasserstoff, C₁₋₆-Alkyl, C₃₋₆-Cycloalkyl, Aryl, Aryl-C₁₋₆-alkyl, Di(aryl)methyl, C₁₋₆-Alkyloxy oder Hydroxyl steht;

Y für NR⁸ oder eine direkte Bindung steht; wobei R⁸ Wasserstoff, C₁₋₆-Alkyl oder Aryl darstellt;

R⁹ und R¹⁰ jeweils unabhängig für Wasserstoff, C₁₋₆-Alkyl, C₃₋₆-Cycloalkyl, Aryl oder Aryl-C₁₋₆-alkyl stehen, oder R⁹ und R¹⁰ zusammen mit dem Stickstoffatom, das R⁹ und R¹⁰ trägt, einen Pyrrolidiny- oder Piperidiny- ring bilden können, die beide jeweils gegebenenfalls durch C₁₋₆-Alkyl, Amino oder Mono- oder Di(C₁₋₆-Alkyl)amino substituiert sind, oder R⁹ und R¹⁰ zusammen mit dem Stickstoff, der R⁹ und R¹⁰ trägt, einen Piperaziny- oder 4-Morpholinyrest bilden können, die beide jeweils gegebenenfalls durch C₁₋₆-Alkyl substituiert sind;

wobei Aryl jeweils für unsubstituiertes Phenyl oder Phenyl, das durch 1, 2 oder 3 Substituenten, die jeweils unabhängig aus Halogen, Hydroxyl, C₁₋₆-Alkyl, C₁₋₆-Alkyloxy, Amino-sulfonyl, C₁₋₆-Alkylcarbonyl, Nitro, Trifluormethyl, Amino oder Aminocarbonyl ausgewählt sind, substituiert ist, steht; und

Het jeweils für einen fünf- oder sechs-gliedrigen heterocyclischen Ring mit 1, 2, 3 oder 4 Heteroatomen, ausgewählt aus Sauerstoff, Schwefel und Stickstoff, steht, mit der Maßgabe, daß nicht mehr als zwei Sauerstoff- und/oder Schwefelatome vorhanden sind, wobei der fünf- oder sechs-gliedrige Ring gegebenenfalls mit einem fünf- oder sechs-gliedrigen carbocyclischen oder heterocyclischen Ring kondensiert ist, der ebenfalls 1, 2, 3 oder 4 Heteroatome, ausgewählt aus Sauerstoff, Schwefel und Stickstoff, enthält, mit der Maßgabe, daß der letztgenannte Ring nicht mehr als zwei Sauerstoff- und/oder Schwefelatome enthält und daß die Gesamtzahl der Heteroatome in dem bicyclischen Ringsystem weniger als 6 beträgt; wobei Het für den Fall, daß es sich um ein monocyclisches Ringsystem handelt, gegebenenfalls durch bis zu 4 Substituenten substituiert sein kann und für den Fall, daß es sich bei Het um ein bicyclisches Ringsystem handelt, gegebenenfalls durch bis zu 6 Substituenten substituiert sein kann; wobei die Substituenten aus der Gruppe bestehend aus Halogen, Hydroxyl, Cyano, Trifluormethyl, C₁₋₆-Alkyl, Aryl-C₁₋₆-Alkyl, Aryl, C₁₋₆-Alkyloxy, C₁₋₆-Alkyloxy-C₁₋₆-alkyl, Hydroxy-C₁₋₆-alkyl, C₁₋₆-Alkylthio, Mercapto, Nitro, Amino, Mono- und Di(C₁₋₆-alkyl)amino, Aryl-C₁₋₆-alkylamino, Aminocarbonyl, Mono- und Di(C₁₋₆-Alkyl)aminocarbonyl, C₁₋₆-Alkyloxycarbonyl, Aryl-C₁₋₆-alkyloxycarbonyl, einem bivalenten Rest =O und =S ausgewählt sind; mit der Maßgabe, daß für den Fall, daß R⁵ für Het steht, Het über ein Kohlenstoffatom mit X verbunden ist.

2. Verbindung nach Anspruch 1, wobei A für einen Rest der Formel (a-1) oder (a-2) steht, wobei das dem Sauerstoff-

atom benachbarte Kohlenstoffatom gegebenenfalls durch einen oder zwei C₁₋₄-Alkyl-Substituenten substituiert ist; R¹ für Wasserstoff oder Halogen steht; R² für Wasserstoff, Amino oder C₁₋₆-Alkylamino steht; R³ für Wasserstoff steht; und

- 5 L für C₃₋₆-Cycloalkyl oder C₃₋₆-Alkenyl steht, welches gegebenenfalls durch Aryl substituiert ist; oder
 L für einen Rest der Formel (b-1) steht, wobei R⁴ für Wasserstoff, Cyano, C₃₋₆-Cycloalkyl, C₅₋₆-Cycloalkanon, Aryl, Di(aryl)methyl oder Het steht; oder
 L für einen Rest der Formel (b-2) steht, wobei X für O, S oder NH steht und R⁵ für Wasserstoff, C₁₋₄-Alkyl, C₃₋₆-Cycloalkyl, Aryl oder Het steht; oder
 10 L für einen Rest der Formel (b-3) steht, wobei Y für NR⁸ oder eine direkte Bindung steht, R⁸ für Wasserstoff oder Aryl steht und R⁷ für Wasserstoff, C₁₋₄-Alkyl, Aryl, C₁₋₄-Alkyloxy oder Hydroxyl steht; oder
 L für einen Rest der Formel (b-4) steht, wobei Y für NH oder eine direkte Bindung steht und R⁹ und R¹⁰ jeweils unabhängig für Wasserstoff oder C₁₋₄-Alkyl stehen, oder R⁹ und R¹⁰ zusammen mit dem Stickstoff, der R⁹ und R¹⁰ trägt, einen Pyrrolidiny- oder Piperidinyrest bilden können.

15 3. Verbindung nach Anspruch 2, wobei

- L für C₅₋₆-Cycloalkyl oder C₃₋₆-Alkenyl steht, welches gegebenenfalls durch Aryl substituiert ist; oder
 L für einen Rest der Formel (b-1) steht, wobei Alk für C₁₋₄-Alkandiyl steht und R⁴ für Cyano, C₃₋₆-Cycloalkyl, Diarylmethyl oder Het steht; oder
 20 L für einen Rest der Formel (b-2) steht, wobei Alk für C₁₋₄-Alkandiyl steht, X für O oder NH steht und R⁵ für Wasserstoff, C₁₋₄-Alkyl, C₃₋₆-Cycloalkyl, Aryl oder Het steht; oder
 L für einen Rest der Formel (b-3) steht, wobei Alk für C₁₋₄-Alkandiyl steht, Y für NH oder eine direkte Bindung steht und R⁷ für C₁₋₄-Alkyl, Aryl, C₁₋₄-Alkyloxy oder Hydroxyl steht.

- 25 4. Verbindung nach Anspruch 3, wobei Het für gegebenenfalls durch C₁₋₄-Alkyl substituiertes Tetrahydrofuran-yl; gegebenenfalls durch C₁₋₄-Alkyl substituiertes 1,3-Dioxolanyl; 3,4-Dihydro-1(2H)-benzopyran-yl; Pyrrolidin-yl; Piperidin-yl; gegebenenfalls durch Cyano substituiertes Pyridin-yl; gegebenenfalls durch C₁₋₄-Alkyl substituiertes Pyrazin-yl; Benzimidazol-yl; Indol-yl; gegebenenfalls durch C₁₋₄-Alkyl substituiertes 2,3-Dihydro-2-oxo-1H-benzimidazol-yl; gegebenfalls durch C₁₋₄-Alkyl substituiertes 2-Oxo-1-imidazolidin-yl; gegebenenfalls durch drei C₁₋₄-Alkyloxy-Gruppen substituiertes 3,4-Dihydro-4-oxo-1,2,3-benzotriazin-3-yl; 1-Oxo-2(1H)-phthalazin-yl; gegebenenfalls durch C₁₋₄-Alkyl substituiertes 2,3-Dihydro-5-oxo-5H-thiazolo-[3,2-a]pyrimidin-6-yl; gegebenenfalls durch C₁₋₄-Alkyl substituiertes 5-Oxo-5H-thiazolo-[3,2-a]pyrimidin-6-yl; gegebenenfalls durch C₁₋₄-Alkyl oder Halogen substituiertes 1,6-Dihydro-6-oxo-1-pyridazin-yl und 1,2,3,4-Tetrahydro-2,4-dioxo-3-chinazolin-yl steht.

- 35 5. Verbindung nach Anspruch 4, wobei R¹ für Wasserstoff oder Chlor steht; R² für Wasserstoff, Amino oder (1-Methylethyl)amino steht; R³ für Wasserstoff steht und L für einen Rest der Formel (b-1) steht, wobei R⁴ für Cyano, Cyclopentyl, Tetrahydrofuran-yl, Piperidin-yl, 7-Methyl-5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yl; 3-Ethyl-2,3-dihydro-2-oxo-1H-benzimidazol-yl oder 1,6-Dihydro-3-methyl-6-oxo-1-pyridazin-yl steht; oder

- 40 L für einen Rest der Formel (b-2) steht, wobei X für O oder NH steht und R⁵ für H oder 4-Fluorphenyl steht; oder
 L für einen Rest der Formel (b-3) steht, wobei Y für NH oder eine direkte Bindung steht und R⁷ für Methyl, Ethoxy oder 3,4,5-Trimethoxyphenyl steht.

45 6. Verbindung nach Anspruch 1, ausgewählt aus der Gruppe

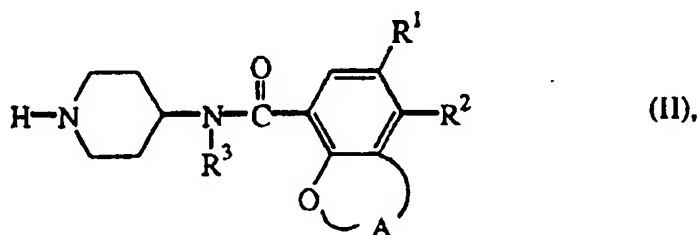
- 5-Amino-6-chlor-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carbonsäureamid;
 50 (-)-(R)-5-Amino-6-chlor-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carbonsäureamid;
 (-)-(R)-4-Amino-5-chlor-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarbonsäureamid; und
 4-Amino-5-chlor-N-[1-(3-cyanopropyl)-4-piperidinyl]-2,3-dihydro-2,2-dimethyl-7-benzofurancarbonsäureamid.

- 55 7. Pharmazeutische Zusammensetzung, enthaltend einen inerten Trägerstoff und, als Wirkstoff, eine die gastrointestinale Motilität stimulierende Menge einer Verbindung gemäß einem der Ansprüche 1 bis 6.

8. Verfahren zur Herstellung einer pharmazeutischen Zusammensetzung nach Anspruch 6, dadurch gekennzeichnet, daß eine therapeutisch wirksame Menge einer Verbindung gemäß einem der Ansprüche 1 bis 6 innig mit einem pharmazeutischen Trägerstoff gemischt wird.

9. Verbindung nach einem der Ansprüche 1 bis 6 zur Verwendung als Arzneimittel.

10. Verbindung der Formel:



20 eine N-Oxidform, ein Salz oder eine stereochemisch isomere Form davon, wobei:

A für einen Rest der Formel



30 steht, wobei ein oder zwei Wasserstoffatome in den Resten (a-1) bis (a-3) durch einen C₁₋₆-Alkylrest ersetzt sein können;

R¹ für Wasserstoff oder Halogen steht;

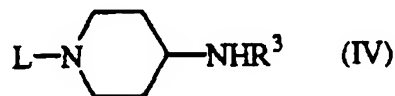
R² für Wasserstoff, Amino, Mono- oder Di(C₁₋₆-alkyl)amino oder C₁₋₆-Alkylcarbonylamino steht; und

R³ für Wasserstoff oder C₁₋₆-Alkyl steht.

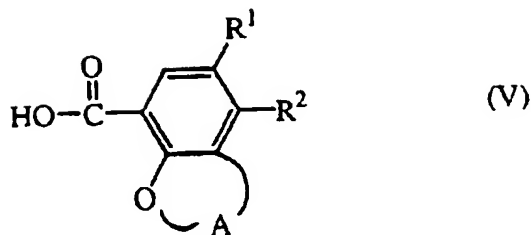
35 11. Verfahren zur Herstellung einer Verbindung der Formel (I) nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß man:

40 a) ein Piperidin der Formel H-D (II) mit einer Zwischenstufe der Formel L-W (III), in der W für eine reaktive Abgangsgruppe steht und L wie unter Formel (I) definiert ist, in einem reaktionsinerten Lösungsmittel gegebenenfalls in Gegenwart einer Base und/oder eines Iodsalzes N-alkyliert;

b) ein Piperidinamin der Formel



50 wobei R³ und L wie unter Formel (I) definiert sind, mit einer Carbonsäure der Formel



oder einem ihrer funktionellen Derivate, wobei R^1 , R^2 und A wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel gegebenenfalls in Gegenwart eines zur Bildung von Amiden fähigen Reagenzes umgesetzt;

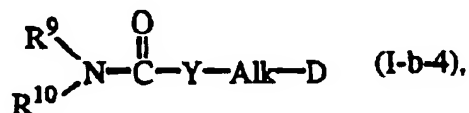
c) eine Zwischenstufe der Formel H-D (II), mit einem Keton oder Aldehyd der Formel $L=O$ (VI), wobei $L=O$ für eine Verbindung der Formel $L=H$ steht, in der zwei geminale Wasserstoffatome im C_{1-6} -Alkanediyl- oder C_{3-6} -Cycloalkandiylteil durch $=O$ ersetzt sind, in einem reaktionsinerten Lösungsmittel reduktiv N-alkyliert;

d) eine Zwischenstufe der Formel $R^{5a}-W^1$ (VII) oder $R^{5a}-X-H$ (VIII), wobei R^{5a} für Aryl oder Het steht, mit einem Piperidin der Formel HX-Alk-D (I-b-2-a) oder W^2 -Alk-D, wobei Alk und X wie unter Formel (I) definiert sind und W^1 und W^2 jeweils reaktive Abgangsgruppen darstellen, in einem reaktionsinerten Lösungsmittel umgesetzt und so eine Verbindung der Formel $R^{5a}-X-Alk-D$ (I-b-2-b) erhält;

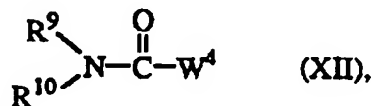
e) ein Amin der Formel R^9-NH-R^{10} (XI), wobei R^9 und R^{10} wie unter Formel (I) definiert sind, mit einer Zwischenstufe der Formel



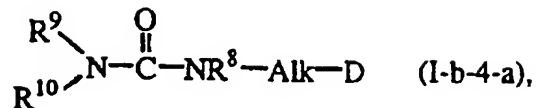
wobei W^3 für eine reaktive Abgangsgruppe steht und Y und Alk wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel umgesetzt und so eine Verbindung der Formel



erhält,
f) ein Amid der Formel

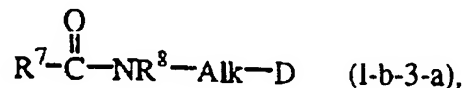


wobei R^9 und R^{10} wie unter Formel (I) definiert sind und W^4 eine reaktive Abgangsgruppe darstellt, mit einem Amin der Formel H-NR⁸-Alk-D (XIII), wobei R^8 und Alk wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel umgesetzt und so eine Verbindung der Formel



erhält,

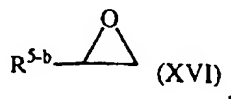
g) eine Carbonsäure der Formel $\text{R}^7\text{-COOH}$ (XIV), wobei R^7 wie unter Formel (I) definiert ist, mit einem Amin der Formel $\text{HNR}^8\text{-Alk-D}$ (XIII), wobei R^8 und Alk wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel



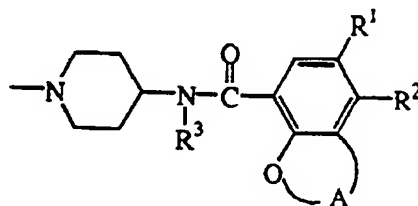
erhält,

h) ein Piperidin der Formel H-D (II) mit einer Zwischenstufe der Formel $\text{R}^{4-a}\text{-C}_{2-6}\text{-Alcendiy-H}$ (XV), wobei R^{4-a} für Cyano, Aryl oder Het steht, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel $\text{R}^{4-a}\text{-C}_{2-6}\text{-Alkandiy-D}$ (I-b-1) erhält;

i) ein Piperidin der Formel H-D (II) mit einem Epoxid



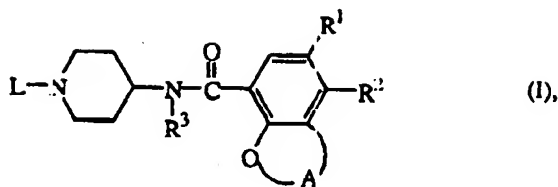
wobei R^{5-b} für H oder $\text{C}_{1-6}\text{-Alkyl}$ steht, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel $\text{HO-CH(R}^{5-b}\text{)-CH}_2\text{-D}$ (I-b-2-c) erhält; wobei D für den Rest



steht, in dem R^1 , R^2 , R^3 und A wie unter Formel (I) definiert sind, oder indem man gegebenenfalls die Verbindungen der Formel (I) durch dem Fachmann bekannte Transformationen funktioneller Gruppen ineinander umwandelt und, falls gewünscht, eine Verbindung der Formel (I) durch Behandlung mit einer geeigneten Säure in ein therapeutisch wirksames nichttoxisches Salz umwandelt oder umgekehrt die Salzform mit Alkali in die freie Base umwandelt; und/oder ihre N-Oxidformen und stereochemisch isomeren Formen herstellt.

Patentansprüche für folgende Vertragsstaaten : ES, GR

1. Verfahren zur Herstellung einer Verbindung der Formel:



10 einer N-Oxidform, eines Salzes oder einer stereochemisch isomeren Form davon, wobei:

A für einen Rest der Formel



steht, wobei ein oder zwei Wasserstoffatome in den Resten (a-1) bis (a-3) durch einen C₁₋₆-Alkyl-Rest ersetzt sein können;

R¹ für Wasserstoff oder Halogen steht;

R² für Wasserstoff, Amino, Mono- oder Di(C₁₋₆-alkyl)amino oder C₁₋₆-Alkylcarbonylamino steht;

25 R³ für Wasserstoff oder C₁₋₆-Alkyl steht;

L für C₃₋₆-Cycloalkyl, C₅₋₆-Cycloalkanon, C₃₋₆-Alkenyl, welches gegebenenfalls durch Aryl substituiert ist, steht oder L für einen Rest der Formel



steht, wobei Alk jeweils für C₁₋₆-Alkandiy l steht; und

R⁴ für Wasserstoff, Cyano, C₁₋₆-Alkylsulfonylamino, C₃₋₆-Cycloalkyl, C₅₋₆-Cycloalkanon, Aryl, Di(aryl)methyl oder Het steht;

40 R⁵ für Wasserstoff, C₁₋₆-Alkyl, Hydroxy-C₁₋₆-alkyl, C₃₋₆-Cycloalkyl, Aryl oder Het steht;

X für O, S, SO₂ oder NR⁶ steht; wobei R⁶ Wasserstoff, C₁₋₆-Alkyl oder Aryl darstellt;

R⁷ für Wasserstoff, C₁₋₆-Alkyl, C₃₋₆-Cycloalkyl, Aryl, Aryl-C₁₋₆-alkyl, Di(aryl)methyl, C₁₋₆-Alkyloxy oder Hydroxyl steht;

Y für NR⁸ oder eine direkte Bindung steht; wobei R⁸ Wasserstoff, C₁₋₆-Alkyl oder Aryl darstellt;

45 R⁹ und R¹⁰ jeweils unabhängig für Wasserstoff, C₁₋₆-Alkyl, C₃₋₆-Cycloalkyl, Aryl oder Aryl-C₁₋₆-alkyl stehen, oder R⁹ und R¹⁰ zusammen mit dem Stickstoffatom, das R⁹ und R¹⁰ trägt, einen Pyrrolidiny l- oder Piperidiny l-ring bilden können, die beide jeweils gegebenenfalls durch C₁₋₆-Alkyl, Amino oder Mono- oder Di(C₁₋₆-Alkyl)amino substituiert sind, oder R⁹ und R¹⁰ zusammen mit dem Stickstoff, der R⁹ und R¹⁰ trägt, einen Piperaziny l- oder 4-Morpholiny lrest bilden können, die beide jeweils gegebenenfalls durch C₁₋₆-Alkyl substituiert sind;

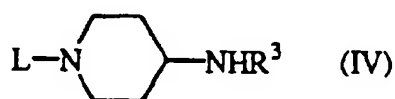
wobei Aryl jeweils für unsubstituiertes Phenyl oder Phenyl, das durch 1, 2 oder 3 Substituenten, die jeweils unabhängig aus Halogen, Hydroxyl, C₁₋₆-Alkyl, C₁₋₆-Alkyloxy, Amino-sulfonyl, C₁₋₆-Alkylcarbonyl, Nitro, Trifluormethyl, Amino oder Aminocarbonyl ausgewählt sind, substituiert ist, steht; und

55 Het jeweils für einen fünf- oder sechs-gliedrigen heterocyclischen Ring mit 1, 2, 3 oder 4 Heteroatomen, ausgewählt aus Sauerstoff, Schwefel und Stickstoff, steht, mit der Maßgabe, daß nicht mehr als zwei Sauerstoff- und/oder Schwefelatome vorhanden sind, wobei der fünf- oder sechs-gliedrige Ring gegebenenfalls mit einem fünf- oder sechs-gliedrigen carbocyclischen oder heterocyclischen Ring kondensiert ist, der ebenfalls 1, 2, 3 oder 4 Heteroatome, ausgewählt aus Sauerstoff, Schwefel und Stickstoff, enthält, mit der Maßgabe, daß der

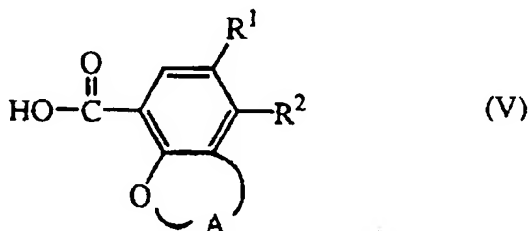
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letztgenannte Ring nicht mehr als zwei Sauerstoff- und/oder Schwefelatome enthält und daß die Gesamtzahl der Heteroatome in dem bicyclischen Ringsystem weniger als 6 beträgt; wobei Het für den Fall, daß es sich um ein monocyclisches Ringsystem handelt, gegebenenfalls durch bis zu 4 Substituenten substituiert sein kann und Het für den Fall, daß es sich um ein bicyclisches Ringsystem handelt, gegebenenfalls durch bis zu 6 Substituenten substituiert sein kann; wobei die Substituenten aus der Gruppe bestehend aus Halogen, Hydroxyl, Cyano, Trifluormethyl, C₁₋₆-Alkyl, Aryl-C₁₋₆-alkyl, Aryl, C₁₋₆-Alkyloxy, C₁₋₆-Alkyloxy-C₁₋₆-alkyl, Hydroxy-C₁₋₆-alkyl, C₁₋₆-Alkylthio, Mercapto, Nitro, Amino, Mono- und Di(C₁₋₆-alkyl)amino, Aryl-C₁₋₆-alkylamino, Aminocarbonyl, Mono- und Di(C₁₋₆-Alkyl)aminocarbonyl, C₁₋₆-Alkyloxycarbonyl, Aryl-C₁₋₆-alkyloxycarbonyl, einem bivalenten Rest =O und =S ausgewählt sind; mit der Maßgabe, daß für den Fall, daß R⁵ für Het steht, Het über ein Kohlenstoffatom mit X verbunden ist; dadurch gekennzeichnet, daß man:

- a) ein Piperidin der Formel H-D (II) mit einer Zwischenstufe der Formel L-W (III), in der W für eine reaktive Abgangsgruppe steht und L wie unter Formel (I) definiert ist, in einem reaktionsinerten Lösungsmittel gegebenenfalls in Gegenwart einer Base und/oder eines Iodsalzes N-alkyliert;
- b) ein Piperidinamin der Formel



wobei R³ und L wie unter Formel (I) definiert sind, mit einer Carbonsäure der Formel

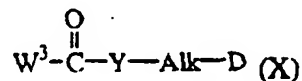


oder einem ihrer funktionellen Derivate, wobei R¹, R² und A wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel gegebenenfalls in Gegenwart eines zur Bildung von Amidien fähigen Reagenzes umsetzt;

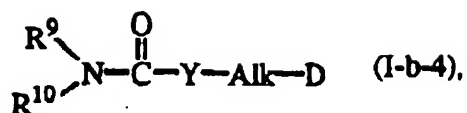
c) eine Zwischenstufe der Formel H-D (II), mit einem Keton oder Aldehyd der Formel L'=O (VI), wobei L'=O für eine Verbindung der Formel L=H steht, in der zwei geminale Wasserstoffatome im C₁₋₆-Alkanediyl- oder C₃₋₆-Cycloalkandiylteil durch =O ersetzt sind, in einem reaktionsinerten Lösungsmittel reduktiv N-alkyliert;

d) eine Zwischenstufe der Formel R^{5-a}-W¹ (VII) oder R^{5-a}-X-H (VIII), wobei R^{5-a} für Aryl oder Het steht, mit einem Piperidin der Formel HX-Alk-D (I-b-2-a) oder W²-Alk-D, wobei Alk und X wie unter Formel (I) definiert sind und W¹ und W² jeweils reaktive Abgangsgruppen darstellen, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel R^{5-a}-X-Alk-D(I-b-2-b) erhält;

e) ein Amin der Formel R⁹-NH-R¹⁰ (XI), wobei R⁹ und R¹⁰ wie unter Formel (I) definiert sind, mit einer Zwischenstufe der Formel

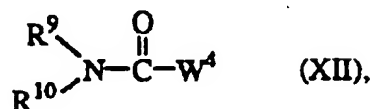


wobei W³ für eine reaktive Abgangsgruppe steht und Y und Alk wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel

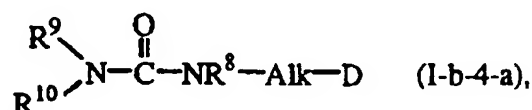


erhält,

f) ein Amid der Formel



wobei R⁹ und R¹⁰ wie unter Formel (I) definiert sind und W⁴ eine reaktive Abgangsgruppe darstellt, mit einem Amin der Formel H-NR⁸-Alk-D (XIII), wobei R⁸ und Alk wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel



erhält,

g) eine Carbonsäure der Formel R⁷-COOH (XIV), wobei R⁷ wie unter Formel (I) definiert ist, mit einem Amin der Formel HNR⁸-Alk-D (XIII), wobei R⁸ und Alk wie unter Formel (I) definiert sind, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel



erhält,

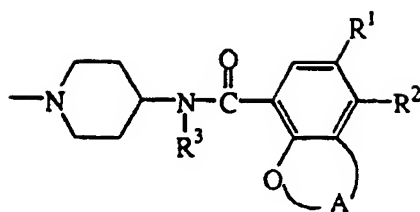
h) ein Piperidin der Formel H-D (II) mit einer Zwischenstufe der Formel R^{4-a}-C₂₋₆-Alcendiyl-H (XV), wobei R^{4-a} für Cyano, Aryl oder Het steht, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel R^{4-a}-C₂₋₆-Alkandiyl-D (I-b-1) erhält;

i) ein Piperidin der Formel H-D (II) mit einem Epoxid



wobei R^{5-b} für H oder C₁₋₆-Alkyl steht, in einem reaktionsinerten Lösungsmittel umsetzt und so eine Verbindung der Formel HO-CH(R^{5-b})-CH₂-D (I-b-2-c) erhält;

wobei D für den Rest



steht, in dem R^1 , R^2 , R^3 und A wie unter Formel (I) definiert sind, oder in dem man gegebenenfalls die Verbindungen der Formel (I) durch dem Fachmann bekannte Transformationen funktioneller Gruppen ineinander umwandelt und, falls gewünscht, eine Verbindung der Formel (I) durch Behandlung mit einer geeigneten Säure in ein therapeutisch wirksames nichttoxisches Salz umwandelt oder umgekehrt die Salzform mit Alkali in die freie Base umwandelt; und/oder ihre N-Oxidformen und stereochemisch isomeren Formen herstellt.

2. Verfahren nach Anspruch 1 zur Herstellung einer Verbindung der Formel (I), wobei A für einen Rest der Formel (a-1) oder (a-2) steht, wobei das dem Sauerstoffatom benachbarte Kohlenstoffatom gegebenenfalls durch einen oder zwei C_{1-4} -Alkyl-Substituenten substituiert ist; R^1 für Wasserstoff oder Halogen steht; R^2 für Wasserstoff, Amino oder C_{1-6} -Alkylamino steht; R^3 für Wasserstoff steht; und L für C_{3-6} -Cycloalkyl oder C_{3-6} -Alkenyl steht, welches gegebenenfalls durch Aryl substituiert ist; oder L für einen Rest der Formel (b-1) steht, wobei R^4 für Wasserstoff, Cyano, C_{3-6} -Cycloalkyl, C_{5-6} -Cycloalkanon, Aryl, Di(aryl)methyl oder Het steht; oder L für einen Rest der Formel (b-2) steht, wobei X für O, S oder NH steht und R^5 für Wasserstoff, C_{1-4} -Alkyl, C_{3-6} -Cycloalkyl, Aryl oder Het steht; oder L für einen Rest der Formel (b-3) steht, wobei Y für NR^8 oder eine direkte Bindung steht, R^8 für Wasserstoff oder Aryl steht und R^7 für Wasserstoff, C_{1-4} -Alkyl, Aryl, C_{1-4} -Alkyloxy oder Hydroxyl steht; oder L für einen Rest der Formel (b-4) steht, wobei Y für NH oder eine direkte Bindung steht und R^9 und R^{10} jeweils unabhängig für Wasserstoff oder C_{1-4} -Alkyl stehen, oder R^9 und R^{10} zusammen mit dem Stickstoff, der R^9 und R^{10} trägt, einen Pyrrolidinyl oder Piperidinylrest bilden können.

3. Verfahren nach Anspruch 1 zur Herstellung einer Verbindung der Formel (I), wobei L für C_{5-6} -Cycloalkyl oder C_{3-6} -Alkenyl steht, welches gegebenenfalls durch Aryl substituiert ist; oder L für einen Rest der Formel (b-1) steht, wobei Alk für C_{1-4} -Alkandiyyl steht und R^4 für Cyano, C_{3-6} -Cycloalkyl, Diarylmethyl oder Het steht; oder L für einen Rest der Formel (b-2) steht, wobei Alk für C_{1-4} -Alkanediyyl steht, X für O oder NH steht und R^5 für Wasserstoff, C_{1-4} -Alkyl, C_{3-6} -Cycloalkyl, Aryl oder Het steht; oder L für einen Rest der Formel (b-3) steht, wobei Alk für C_{1-4} -Alkanediyyl steht, Y für NH oder eine direkte Bindung steht und R^7 für C_{1-4} -Alkyl, Aryl, C_{1-4} -Alkyloxy oder Hydroxyl steht.

4. Verfahren nach Anspruch 1 zur Herstellung einer Verbindung der Formel (I), ausgewählt aus der Gruppe

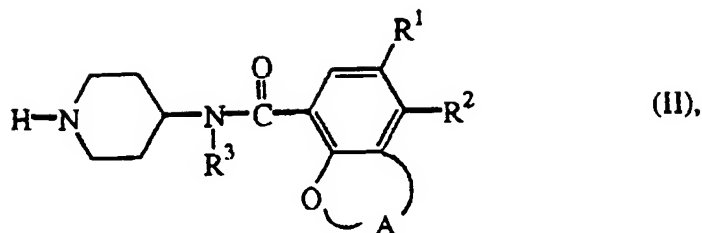
5-Amino-6-chlor-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carbonsäureamid;

(-)-(R)-5-Amino-6-chlor-3,4-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-2H-1-benzopyran-8-carbonsäureamid;

(-)-(R)-4-Amino-5-chlor-2,3-dihydro-N-[1-[(tetrahydro-2-furanyl)methyl]-4-piperidinyl]-7-benzofurancarbonsäureamid; und

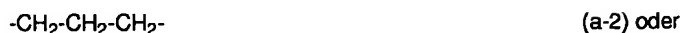
4-Amino-5-chlor-N-[1-(3-cyanopropyl)-4-piperidinyl]-2,3-dihydro-2,2-dimethyl-7-benzofurancarbonsäureamid.

5. Verfahren zur Herstellung einer Verbindung der Formel



einer N-Oxidform, eines Salzes oder einer stereochemisch isomeren Form davon, wobei:

15 A für einen Rest der Formel



steht, wobei ein oder zwei Wasserstoffatome in den Resten (a-1) bis (a-3) durch einen C₁₋₆-Alkylrest ersetzt sein können;

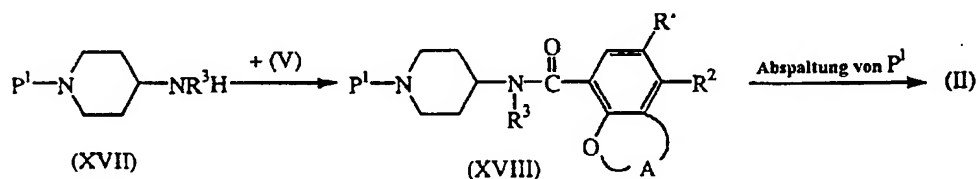
25 R¹ für Wasserstoff oder Halogen steht;

R² für Wasserstoff, Amino, Mono- oder Di(C₁₋₆-alkyl)amino oder C₁₋₆-Alkylcarbonylamino steht; und

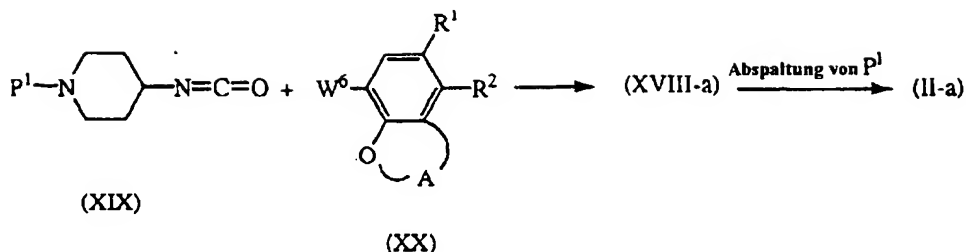
R³ für Wasserstoff oder C₁₋₆-Alkyl steht;

dadurch gekennzeichnet, daß man

30 a) ein entsprechend substituiertes Piperidin der Formel (XVII), wobei R³ für Wasserstoff oder C₁₋₆-Alkyl und P¹ für eine geeignete Schutzgruppe, die leicht durch Hydrierung oder Hydrolyse abgespalten werden kann, wie zum Beispiel Phenylmethyl, oder eine hydrolysierbare Gruppe, wie C₁₋₄-Alkyloxycarbonyl, z.B. Ethoxycarbonyl, Benzoyloxycarbonyl, steht, mit einem Reagenz der Formel (V) oder einem seiner funktionellen Derivate umsetzt und anschließend die Schutzgruppe P¹ in der so erhaltenen Zwischenstufe (XVIII) in Abhängigkeit von der Beschaffenheit von P¹ durch dem Fachmann bekannte Methoden, z.B. durch Hydrolyse in einem sauren oder alkalischen Medium oder durch katalytische Hydrierung, abspaltet;



50 b) ein Isocyanat der Formel (XIX) mit einer Zwischenstufe der Formel (XX), wobei W⁵ für ein Alkalimetall, z.B. Lithium, Natrium usw. oder für Magnesiumhalogenid, z.B. Magnesiumbromid oder Magnesiumchlorid steht, umsetzt und so eine Zwischenstufe der Formel (XVIII) erhält, in der R³ für H steht, wobei die Zwischenstufe durch die Formel (XVIII-a) dargestellt wird; und man wie oben beschrieben entschützt, und so die Zwischenstufen der Formel (II-a) erhält, in denen R³ für Wasserstoff steht



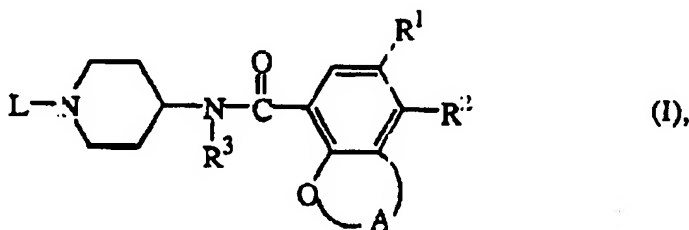
oder indem man gegebenenfalls die Verbindungen der Formel (I) durch dem Fachmann bekannte Transformationen funktioneller Gruppen ineinander umwandelt und, falls gewünscht, eine Verbindung der Formel (I) durch Behandlung mit einer geeigneten Säure in ein therapeutisch wirksames nichttoxisches Salz umwandelt oder umgekehrt die Salzform mit Alkali in die freie Base umwandelt; und/oder ihre N-Oxidformen und stereochemisch isomeren Formen herstellt.

6. Verfahren zur Herstellung einer pharmazeutischen Zusammensetzung enthaltend einen inerten Trägerstoff und, als Wirkstoff, eine die gastrointestinale Motilitätstimulierende Menge einer Verbindung der Formel (I);
dadurch gekennzeichnet, daß man eine therapeutisch wirksame Menge einer Verbindung der Formel (I) innig mit einem pharmazeutischen Trägerstoff mischt.

Revendications

Revendications pour les Etats contractants suivants : DE, GB, FR, IT, NL, SE, LI, CH, BE, AT, LU, DK

1. Composé de formule :



forme N-oxyde, sel ou forme stéréochimiquement isomère de celui-ci, où :

A est un radical de formules



dans lesquelles un ou deux atomes d'hydrogène dans lesdits radicaux (a-1) à (a-3) peuvent être remplacés par un radical alkyle en C₁₋₆ ;

R¹ est un hydrogène ou un halogéno ;

R² est un hydrogène, un amino, un mono- ou di(C₁₋₆-alkyl)amino ou un C₁₋₆-alkylcarbonylamino ;

R³ est un hydrogène ou un alkyle en C₁₋₆ ;

L est un cycloalkyle en C₃₋₆, une cycloalkanone en C₅₋₆, un alcényle en C₃₋₆ éventuellement substitué par un aryle, ou L est un radical de formules

-Alk-R⁴ (b-1),

-Alk-X-R⁵ (b-2),

5 -Alk-Y-C(=O)-R⁷ (b-3), ou

-Alk-Y-C(=O)-NR⁹R¹⁰ (b-4),

dans lesquelles chaque Alk est un C₁₋₆-alcanediyle ; et

10 R⁴ est un hydrogène, un cyano, un C₁₋₆-alkylsulfonylamino, un cycloalkyle en C₃₋₆, une cycloalcanone en C₅₋₆, un aryle, un di(aryl)méthyle ou un Het ;

R⁵ est un hydrogène, un alkyle en C₁₋₆, un hydroxyalkyle en C₁₋₆, un cycloalkyle en C₃₋₆, un aryle ou un Het ;
X est O, S, SO₂ ou NR⁶ ; ledit R⁶ étant un hydrogène, un alkyle en C₁₋₆, ou un aryle ;

15 R⁷ est un hydrogène, un alkyle en C₁₋₆, un cycloalkyle en C₃₋₆, un aryle, un aryl-C₁₋₆-alkyle, un di(aryl)méthyle, un alkyloxy en C₁₋₆ ou un hydroxy ;

Y est NR⁸ ou une liaison directe ; ledit R⁸ étant un hydrogène, un alkyle en C₁₋₆, ou un aryle ;

20 R⁹ et R¹⁰ sont chacun indépendamment un hydrogène, un alkyle en C₁₋₆, un cycloalkyle en C₃₋₆, un aryle ou un aryl-C₁₋₆-alkyle, ou R⁹ et R¹⁰ peuvent former, conjointement avec l'atome d'azote portant R⁹ et R¹⁰, un noyau pyrrolidinyle ou pipéridinyle étant tous deux éventuellement substitués par un alkyle en C₁₋₆, un amino ou mono- ou di(C₁₋₆-alkyl)amino, ou lesdits R⁹ et R¹⁰ peuvent former, conjointement avec l'azote portant R⁹ et R¹⁰, un radical pipérazinyle ou 4-morpholinyle étant tous deux éventuellement substitués par un alkyle en C₁₋₆ ;

25 chaque aryle étant un phényle non substitué ou un phényle substitué par 1, 2 ou 3 substituants, chacun choisi indépendamment parmi un halogéno, un hydroxy, un alkyle en C₁₋₆, un alkyloxy en C₁₋₆, un aminosulfonyl, un C₁₋₆-alkylcarbonyl, un nitro, un trifluorométhyle, un amino ou aminocarbonyl ; et

30 chaque Het étant un noyau hétérocyclique à cinq ou six chaînons renfermant 1, 2, 3 ou 4 hétéroatomes choisis parmi un oxygène, un soufre et un azote, à condition que pas plus de 2 atomes d'oxygène et/ou de soufre soient présents, ledit noyau à cinq ou six chaînons étant éventuellement condensé avec un noyau hétérocyclique ou carboxylique à cinq ou six chaînons renfermant également 1, 2, 3 ou 4 hétéroatomes choisis parmi un oxygène, un soufre et un azote, à condition que ce dernier noyau ne renferme pas plus de 2 atomes d'oxygène et/ou de soufre et que le nombre total d'hétéroatomes dans le système de noyaux bicycliques soit inférieur à 6 ; lorsque Het est un système de noyau monocyclique, il peut être éventuellement substitué par jusqu'à 4 substituants ; lorsque Het est un système de noyau bicyclique, il peut être éventuellement substitué par jusqu'à 6 substituants ; lesdits substituants étant choisis parmi le groupe constitué d'un halogéno, d'un hydroxy, d'un cyano, d'un trifluorométhyle, d'un alkyle en C₁₋₆, d'un aryl-C₁₋₆-alkyle, d'un aryle, d'un alkyloxy en C₁₋₆, d'un C₁₋₆-alkyloxy-C₁₋₆-alkyle, d'un hydroxy-C₁₋₆-alkyle, d'un C₁₋₆-alkylthio, d'un mercapto, d'un nitro, d'un amino, d'un mono- et d'un di(C₁₋₆-alkyl)amino, d'un aryl-C₁₋₆-alkylamino, d'un aminocarbonyl, d'un mono- et d'un di(C₁₋₆-alkyl)aminocarbonyl, d'un C₁₋₆-alkyloxy-carbonyl, d'un aryl-C₁₋₆-alkyloxy-carbonyl, d'un radical bivalent =O et =S ; à condition que lorsque R⁵ est Het, Het soit relié à X sur un atome de carbone.

- 40 2. Composé selon la revendication 1, dans lequel A est un radical de formules (a-1) ou (a-2) dans lesquelles l'atome de carbone adjacent à l'atome d'oxygène est éventuellement substitué par un ou deux substituants alkyle en C₁₋₄ ; R¹ est un hydrogène ou un halogéno ; R² est un hydrogène, un amino ou un C₁₋₆-alkylamino ; R³ est un hydrogène ; et

45 L est un cycloalkyle en C₃₋₆ ou un alcényle en C₃₋₆ éventuellement substitué par un aryle ; ou

L est un radical de formule (b-1), dans laquelle R⁴ est un hydrogène, un cyano, un cycloalkyle en C₃₋₆, une cycloalcanone en C₅₋₆, un aryle, un di(aryl)méthyle ou un Het ; ou

50 L est un radical de formule (b-2), dans laquelle X est O, S ou NH et R⁵ est un hydrogène, un alkyle en C₁₋₄, un cycloalkyle en C₃₋₆, un aryle ou un Het ; ou

L est un radical de formule (b-3), dans laquelle Y est NR⁸ ou une liaison directe, R⁸ est un hydrogène ou un aryle et R⁷ est un hydrogène, un alkyle en C₁₋₄, un aryle, un alkyloxy en C₁₋₄ ou un hydroxy ; ou

55 L est un radical de formule (b-4), dans laquelle Y est NH ou une liaison directe et R⁹ et R¹⁰ sont chacun indépendamment un hydrogène ou un alkyle en C₁₋₄, ou R⁹ et R¹⁰ peuvent former, conjointement avec l'azote portant lesdits R⁹ et R¹⁰, un radical pyrrolidinyle ou pipéridinyle.

3. Composé selon la revendication 2, dans lequel

L est un cycloalkyle en C₅₋₆ ou un alcényle en C₃₋₆ éventuellement substitué par un aryle ; ou

L est un radical de formule (b-1), dans laquelle Alk est un C₁₋₄-alcanediyle et R⁴ est un cyano, un cycloalkyle en C₃₋₆, un diarylméthyle ou un Het ; ou

L est un radical de formule (b-2), dans laquelle Alk est un C₁₋₄-alcanediyle, X est O ou NH et R⁵ est un hydrogène, un alkyle en C₁₋₄, un cycloalkyle en C₃₋₆, un aryle ou un Het ; ou

L est un radical de formule (b-3), dans laquelle Alk est un C₁₋₄-alcanediyle, Y est NH ou une liaison directe et R⁷ est un alkyle en C₁₋₄, un aryle, un alkyloxy en C₁₋₄ ou un hydroxy.

4. Composé selon la revendication 3, dans lequel Het est un tétrahydrofuranyle éventuellement substitué par un alkyle en C₁₋₄ ; un 1,3-dioxolanyle éventuellement substitué par un alkyle en C₁₋₄ ; un 3,4-dihydro-1(2H)-benzopyranyle ; un pyrrolidinyle ; un pipéridinyle, un pyridinyle éventuellement substitué par un cyano ; un pyrazinyle éventuellement substitué par un alkyle en C₁₋₄ ; un benzimidazolyle ; un indolyte ; un 2,3-dihydro-2-oxo-1H-benzimidazolyle éventuellement substitué par un alkyle en C₁₋₄ ; un 2-oxo-1-imidazolidinyle éventuellement substitué par un alkyle en C₁₋₄ ; un 3,4-dihydro-4-oxo-1,2,3-benzotriazine-3-yle éventuellement substitué par trois groupes alkyloxy en C₁₋₄ ; un 1-oxo-2(1H)-phthalazinyle ; un 2,3-dihydro-5-oxo-5H-thiazolo-[3,2-a]pyrimidin-6-yle éventuellement substitué par un alkyle en C₁₋₄ ; un 5-oxo-5H-thiazolo-[3,2-a]pyrimidin-6-yle éventuellement substitué par un alkyle en C₁₋₄ ; un 1,6-dihydro-6-oxo-1-pyridazinyle éventuellement substitué par un alkyle en C₁₋₄ ou un halogéno ; et un 1,2,3,4-tétrahydro-2,4-dioxo-3-quinazolinyle.

5. Composé selon la revendication 4, dans lequel R¹ est un hydrogène ou un chloro ; R² est un hydrogène, un amino ou un (1-méthyléthyl)amino ; R³ est un hydrogène ; et L est un radical de formule (b-1), dans laquelle R⁴ est un cyano, un cyclopentyle, un tétrahydrofuranyle, un pipéridinyle, un 7-méthyl-5-oxo-5H-thiazolo[3,2-a]pyrimidin-6-yle ; un 3-éthyl-2,3-dihydro-2-oxo-1H-benzimidazolyle ; un 1,6-dihydro-3-méthyl-6-oxo-1-pyridazinyle ; ou

L est un radical de formule (b-2), dans laquelle X est O ou NH et R⁵ est H ou un 4-fluorophényle ; ou

L est un radical de formule (b-3), dans laquelle Y est NH ou une liaison directe et R⁷ est un méthyle, un éthoxy ou un 3,4,5-triméthoxyphényle.

6. Composé selon la revendication 1, choisi parmi le groupe constitué

du 5-amino-6-chloro-3,4-dihydro-N-[1-[(tétrahydro-2-furanyl)méthyl]-4-pipéridinyl]-2H-1-benzopyran-8-carboxamide ;

du (-)-(R)-5-amino-6-chloro-3,4-dihydro-N-[1-[(tétrahydro-2-furanyl)méthyl]-4-pipéridinyl]-2H-1-benzopyrane-8-carboxamide ;

du (-)-(R)-4-amino-5-chloro-2,3-dihydro-N-[1-[(tétrahydro-2-furanyl)méthyl]-4-pipéridinyl]-7-benzofuranecarboxamide ; et

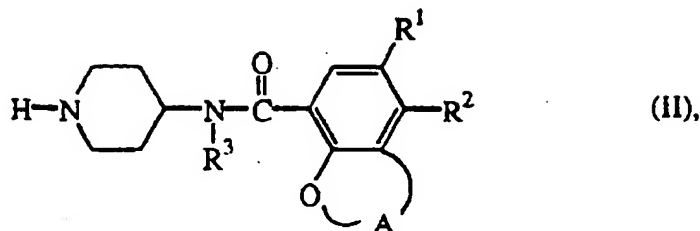
du 4-amino-5-chloro-N-[1-(3-cyanopropyl)-4-pipéridinyl]-2,3-dihydro-2,2-diméthyl-7-benzofuranecarboxamide.

7. Composition pharmaceutique comprenant un support inerte et, en tant qu'ingrédient actif, une quantité d'un composé selon l'une quelconque des revendications 1 à 6, stimulant la motilité gastro-intestinale.

8. Méthode de préparation d'une composition pharmaceutique selon la revendication 6, caractérisée en ce qu'une quantité thérapeutiquement efficace d'un composé selon l'une quelconque des revendications 1 à 6 est mélangée intimement avec un support pharmaceutique.

9. Composé selon l'une quelconque des revendications 1 à 6, destiné à être utilisé en tant que médicament.

10. Composé de formule :



forme N-oxyde, sel ou forme stéréochimiquement isomère de celui-ci, où :

15 A est un radical de formules



dans lesquelles un ou deux atomes d'hydrogène dans lesdits radicaux (a-1) à (a-3) peuvent être remplacés par un radical alkyle en C₁₋₆ ;

25 R¹ est un hydrogène ou un halogéno ;

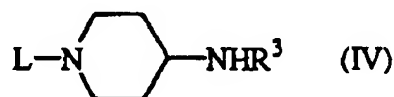
R² est un hydrogène, un amino, un mono- ou di(C₁₋₆-alkyl)amino ou un C₁₋₆-alkylcarbonylamino ; et

R³ est un hydrogène ou un alkyle en C₁₋₆.

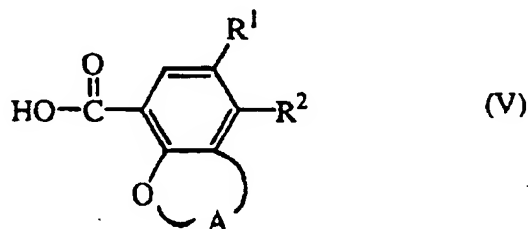
30 11. Procédé de préparation d'un composé de formule (I) selon l'une quelconque des revendications 1 à 6, caractérisé par :

a) la N-alkylation d'une pipéridine de formule H-D (II) avec un intermédiaire de formule L-W (III), dans laquelle W est un groupe partant réactif et L est tel que défini pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, éventuellement en présence d'une base et/ou d'un sel d'iodure ;

35 b) la réaction d'une pipéridinamine de formule



dans laquelle R³ et L sont tels que définis pour la formule (I), avec un acide carboxylique de formule



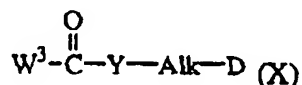
55 ou un dérivé fonctionnel de celui-ci, où R¹, R² et A sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, éventuellement en présence d'un réactif capable de former des amides ;

c) la N-alkylation réductive d'un intermédiaire de formule H-D (II) avec une cétone ou un aldéhyde de formule L=O (VI), dans laquelle L=O est un composé de formule L-H dans laquelle deux atomes d'hydrogène géminés

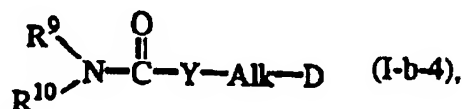
dans le groupement C₁₋₆-alcanediyle ou C₃₋₆-cycloalcanediyle sont remplacés par =O, dans un solvant inerte vis-à-vis de la réaction ;

d) la réaction d'un intermédiaire de formules R^{5-a}-W¹ (VII) ou R^{5-a}-X-H (VIII), dans lesquelles R^{5-a} est un aryle ou un Het, avec une pipéridine de formules HX-Alk-D (I-b-2-a) ou W²-Alk-D, dans lesquelles Alk et X sont tels que définis pour la formule (I), et W¹ et W² sont tous les deux des groupes partants réactifs, dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule R^{5-a}-X-Alk-D (I-b-2-b) ;

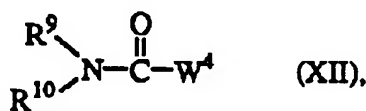
e) la réaction d'une amine de formule R⁹-NH-R¹⁰ (XI), dans laquelle R⁹ et R¹⁰ sont tels que définis pour la formule (I), avec un intermédiaire de formule



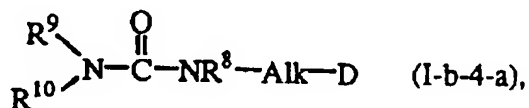
dans laquelle W³ est un groupe partant réactif et Y et Alk sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule



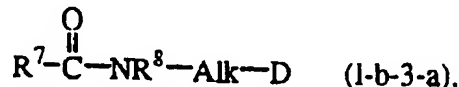
f) la réaction d'un amide de formule



dans laquelle R⁹ et R¹⁰ sont tels que définis pour la formule (I) et W⁴ est un groupe partant réactif, avec une amine de formule H-NR⁸-Alk-D (XIII), dans laquelle R⁸ et Alk sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule



g) la réaction d'un acide carboxylique de formule R⁷-COOH (XIV), dans laquelle R⁷ est tel que défini pour la formule (I), avec une amine de formule HNR⁸-Alk-D (XIII), dans laquelle R⁸ et Alk sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule

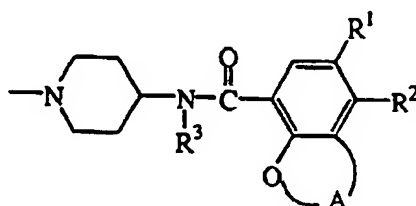


h) la réaction d'une pipéridine de formule H-D (II) avec un intermédiaire de formule R^{4-a}-C₂₋₆-alcènediyl-H (XV), dans laquelle R^{4-a} est un cyano, un aryle ou un Het, dans un solvant inerte vis-à-vis de la réaction, en

donnant ainsi lieu à un composé de formule R^{4-a} -C₂₋₆-alcanediyl-D (I-b-1) ;
 i) la réaction d'une pipéridine de formule H-D (II) avec un époxyde



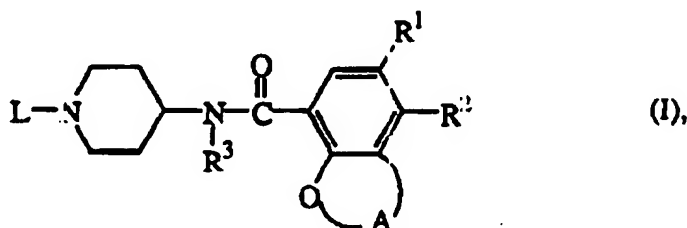
10 dans laquelle R^{5-b} est H ou un alkyle en C₁₋₆, dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule HO-CH(R^{5-b})-CH₂-D (I-b-2-c) ;
 et D représente le radical



25 où R^1 , R^2 , R^3 et A sont tels que définis pour la formule (I), ou la transformation éventuelle des composés de formule (I) les uns en les autres en suivant des modes opératoires de transformation de groupes fonctionnels connus dans l'art, et, si on le souhaite, la transformation d'un composé de formule (I) en un sel thérapeutiquement actif et non toxique par traitement avec un acide approprié ou inversement, la transformation de la forme de sel en forme basique libre avec un alcali ; et/ou la préparation de formes N-oxyde et de formes stéréochimiquement isomères de celui-ci.

Revendications pour les Etats contractants suivants : ES, GR

1. Procédé de préparation d'un composé de formule :



forme N-oxyde, sel ou forme stéréochimiquement isomère de celui-ci, où :

45 A est un radical de formules



dans lesquelles un ou deux atomes d'hydrogène dans lesdits radicaux (a-1) à (a-3) peuvent être remplacés par un radical alkyle en C₁₋₆ ;

55 R^1 est un hydrogène ou un halogéno ;

R^2 est un hydrogène, un amino, un mono- ou di(C₁₋₆-alkyl)amino ou un C₁₋₆-alkylcarbonylamino ;

R^3 est un hydrogène ou un alkyle en C₁₋₆ ;

L est un cycloalkyle en C₃₋₆, une cycloalcanone en C₅₋₆, un alcényle en C₃₋₆ éventuellement substitué par un

aryle, ou L est un radical de formules



dans lesquelles chaque Alk est un C₁₋₆-alcanediyle ; et

R⁴ est un hydrogène, un cyano, un C₁₋₆-alkylsulfonylamino, un cycloalkyle en C₃₋₆, une cycloalcanone en C₅₋₆, un aryle, un di(aryl)méthyle ou un Het ;

R⁵ est un hydrogène, un alkyle en C₁₋₆, un hydroxyalkyle en C₁₋₆, un cycloalkyle en C₃₋₆, un aryle ou un Het ; X est O, S, SO₂ ou NR⁶ ; ledit R⁶ étant un hydrogène, un alkyle en C₁₋₆, ou un aryle ;

R⁷ est un hydrogène, un alkyle en C₁₋₆, un cycloalkyle en C₃₋₆, un aryle, un aryl-C₁₋₆-alkyle, un di(aryl)méthyle, un alkyloxy en C₁₋₆ ou un hydroxy ;

Y est NR⁸ ou une liaison directe ; ledit R⁸ étant un hydrogène, un alkyle en C₁₋₆, ou un aryle ;

R⁹ et R¹⁰ sont chacun indépendamment un hydrogène, un alkyle en C₁₋₆, un cycloalkyle en C₃₋₆, un aryle ou un aryl-C₁₋₆-alkyle, ou R⁹ et R¹⁰ peuvent former, conjointement avec l'atome d'azote portant R⁹ et R¹⁰, un noyau pyrrolidinylique ou pipéridinylique étant tous deux éventuellement substitués par un alkyle en C₁₋₆, un amino ou mono- ou di(C₁₋₆-alkyl)amino, ou lesdits R⁹ et R¹⁰ peuvent former, conjointement avec l'azote portant R⁹ et R¹⁰, un radical pipérazinyle ou 4-morpholinyle étant tous deux éventuellement substitués par un alkyle en C₁₋₆ ;

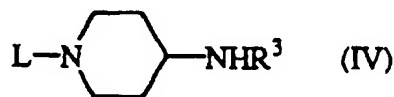
chaque aryle étant un phényle non substitué ou un phényle substitué par 1, 2 ou 3 substituants, chacun choisi indépendamment parmi un halogéno, un hydroxy, un alkyle en C₁₋₆, un alkyloxy en C₁₋₆, un aminosulfonyle, un C₁₋₆-alkylcarbonyle, un nitro, un trifluorométhyle, un amino ou aminocarbonyle ; et

chaque Het étant un noyau hétérocyclique à cinq ou six chaînons renfermant 1, 2, 3 ou 4 hétéroatomes choisis parmi un oxygène, un soufre et un azote, à condition que pas plus de 2 atomes d'oxygène et/ou de soufre soient présents, ledit noyau à cinq ou six chaînons étant éventuellement condensé avec un noyau hétérocyclique ou carboxylique à cinq ou six chaînons renfermant également 1, 2, 3 ou 4 hétéroatomes choisis parmi un oxygène, un soufre et un azote, à condition que ce dernier noyau ne renferme pas plus de 2 atomes d'oxygène et/ou de soufre et que le nombre total d'hétéroatomes dans le système de noyaux bicycliques soit inférieur à 6 ; lorsque Het est un système de noyau monocyclique, il peut être éventuellement substitué par jusqu'à 4 substituants ; lorsque Het est un système de noyau bicyclique, il peut être éventuellement substitué par jusqu'à 6 substituants ; lesdits substituants étant choisis parmi le groupe constitué d'un halogéno, d'un hydroxy, d'un cyano, d'un trifluorométhyle, d'un alkyle en C₁₋₆, d'un aryl-C₁₋₆-alkyle, d'un aryle, d'un alkyloxy en C₁₋₆, d'un C₁₋₆-alkyloxy-C₁₋₆-alkyle, d'un hydroxy-C₁₋₆-alkyle, d'un C₁₋₆-alkylthio, d'un mercapto, d'un nitro, d'un amino, d'un mono- et d'un di(C₁₋₆-alkyl)amino, d'un aryl-C₁₋₆-alkylamino, d'un aminocarbonyle, d'un mono- et d'un di(C₁₋₆-alkyl)aminocarbonyle, d'un C₁₋₆-alkyloxy-carbonyle, d'un aryl-C₁₋₆-alkyloxycarbonyle, d'un radical bivalent =O et =S ; à condition que lorsque R⁵ est Het, Het soit relié à X sur un atome de carbone ;

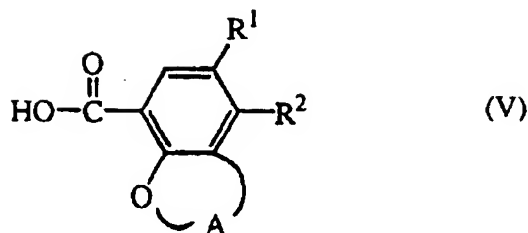
caractérisé par :

a) la N-alkylation d'une pipéridine de formule H-D (II) avec un intermédiaire de formule L-W (III), dans laquelle W est un groupe partant réactif et L est tel que défini pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, éventuellement en présence d'une base et/ou d'un sel d'iodure ;

b) la réaction d'une pipéridinamine de formule



dans laquelle R³ et L sont tels que définis pour la formule (I), avec un acide carboxylique de formule

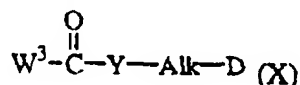


ou un dérivé fonctionnel de celui-ci, où R^1 , R^2 et A sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, éventuellement en présence d'un réactif capable de former des amides ;

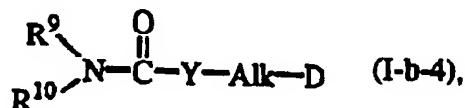
15 c) la N-alkylation réductive d'un intermédiaire de formule H-D (II) avec une cétone ou un aldéhyde de formule $L'=O$ (VI), dans laquelle $L'=O$ est un composé de formule L-H dans laquelle deux atomes d'hydrogène géminés dans le groupement C_{1-6} -alcanediyle ou C_{3-6} -cycloalcanediyle sont remplacés par $=O$, dans un solvant inerte vis-à-vis de la réaction ;

20 d) la réaction d'un intermédiaire de formules $R^{5-a}-W^1$ (VII) ou $R^{5-a}-X-H$ (VIII), dans lesquelles R^{5-a} est un aryle ou un Het, avec une pipéridine de formules $HX-Alk-D$ (I-b-2-a) ou $W^2-Alk-D$, dans lesquelles Alk et X sont tels que définis pour la formule (I), et W^1 et W^2 sont tous les deux des groupes partants réactifs, dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule $R^{5-a}-X-Alk-D$ (I-b-2-b) ;

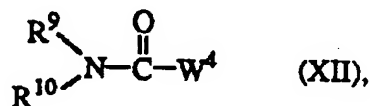
25 e) la réaction d'une amine de formule R^9-NH-R^{10} (XI), dans laquelle R^9 et R^{10} sont tels que définis pour la formule (I), avec un intermédiaire de formule



dans laquelle W^3 est un groupe partant réactif et Y et Alk sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule

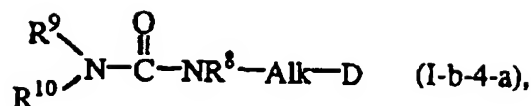


f) la réaction d'un amide de formule

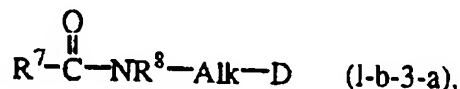


dans laquelle R^9 et R^{10} sont tels que définis pour la formule (I) et W^4 est un groupe partant réactif, avec une amine de formule $H-NR^8-Alk-D$ (XIII), dans laquelle R^8 et Alk sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule

55



g) la réaction d'un acide carboxylique de formule $\text{R}^7\text{-COOH}$ (XIV), dans laquelle R^7 est tel que défini pour la formule (I), avec une amine de formule $\text{HNR}^8\text{-Alk-D}$ (XIII), dans laquelle R^8 et Alk sont tels que définis pour la formule (I), dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule

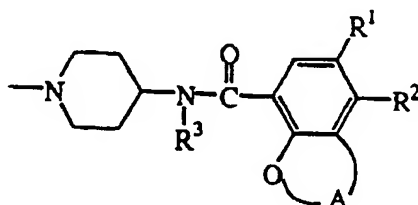


h) la réaction d'une pipéridine de formule H-D (II) avec un intermédiaire de formule $\text{R}^{4-a}\text{-C}_{2-6}\text{-alcènediyl-H}$ (XV), dans laquelle R^{4-a} est un cyano, un aryle ou un Het, dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule $\text{R}^{4-a}\text{-C}_{2-6}\text{-alcanediyl-D}$ (I-b-1) ;

i) la réaction d'une pipéridine de formule H-D (II) avec un époxyde



dans laquelle R^{5-b} est H ou un alkyle en C_{1-6} , dans un solvant inerte vis-à-vis de la réaction, en donnant ainsi lieu à un composé de formule $\text{HO-CH(R}^{5-b}\text{)-CH}_2\text{-D}$ (I-b-2-c) ;
et D représente le radical



où R^1 , R^2 , R^3 et A sont tels que définis pour la formule (I), ou la transformation éventuelle des composés de formule (I) les uns en les autres en suivant des modes opératoires de transformation de groupes fonctionnels connus dans l'art, et, si on le souhaite, la transformation d'un composé de formule (I) en un sel thérapeutiquement actif et non toxique par traitement avec un acide approprié ou inversement, la transformation de la forme de sel en forme basique libre avec un alcali ; et/ou la préparation de formes N-oxyde et de formes stéréochimiquement isomères de celui-ci.

- Procédé selon la revendication 1, de préparation d'un composé de formule (I), dans laquelle A est un radical de formules (a-1) ou (a-2) dans lesquelles l'atome de carbone adjacent à l'atome d'oxygène est éventuellement substitué par un ou deux substituants alkyle en C_{1-4} ; R^1 est un hydrogène ou un halogène ; R^2 est un hydrogène, un amino ou un C_{1-6} -alkylamino ; R^3 est un hydrogène ; et L est un cycloalkyle en C_{3-6} ou un alcényle en C_{3-6} éventuellement substitué par un aryle ; ou L est un radical de formule (b-1), dans laquelle R^4 est un hydrogène, un cyano, un cycloalkyle en C_{3-6} , une cycloalcanone en C_{5-6} , un aryle, un di(aryl)méthyle ou un Het ; ou L est un radical de formule (b-2), dans laquelle X est O, S ou NH et R^5 est un hydrogène, un alkyle en C_{1-4} , un cycloalkyle en

C₃₋₆, un aryle ou un Het ; ou L est un radical de formule (b-3), dans laquelle Y est NR⁸ ou une liaison directe, R⁸ est un hydrogène ou un aryle et R⁷ est un hydrogène, un alkyle en C₁₋₄, un aryle, un alkyloxy en C₁₋₄ ou un hydroxy ; ou L est un radical de formule (b-4), dans laquelle Y est NH ou une liaison directe et R⁹ et R¹⁰ sont chacun indépendamment un hydrogène ou un alkyle en C₁₋₄, ou R⁹ et R¹⁰ peuvent former, conjointement avec l'azote portant lesdits R⁹ et R¹⁰, un radical pyrrolidinyle ou pipéridinyle.

3. Procédé selon la revendication 1, de préparation d'un composé de formule (I), dans laquelle L est un cycloalkyle en C₅₋₆ ou un alcényle en C₃₋₆ éventuellement substitué par un aryle ; ou L est un radical de formule (b-1), dans laquelle Alk est un C₁₋₄-alcanediyle et R⁴ est un cyano, un cycloalkyle en C₃₋₆, un diarylméthyle ou un Het ; ou L est un radical de formule (b-2), dans laquelle Alk est un C₁₋₄-alcanediyle, X est O ou NH et R⁵ est un hydrogène, un alkyle en C₁₋₄, un cycloalkyle en C₃₋₆, un aryle ou un Het ; ou L est un radical de formule (b-3), dans laquelle Alk est un C₁₋₄-alcanediyle, Y est NH ou une liaison directe et R⁷ est un alkyle en C₁₋₄, un aryle, un alkyloxy en C₁₋₄ ou un hydroxy.

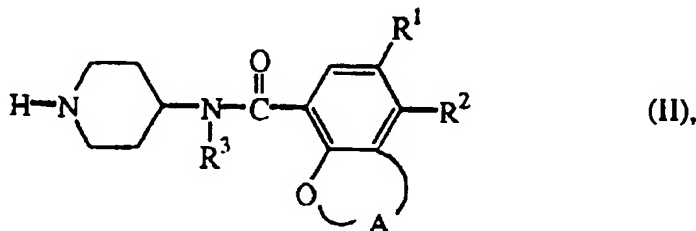
4. Procédé selon la revendication 1, de préparation d'un composé de formule (I), choisi parmi le groupe constitué du

du (-)-(R)-5-amino-6-chloro-3,4-dihydro-N-[1-[(tétrahydro-2-furanyl)méthyl]-4-pipéridinyl]-2H-1-benzopyrane-8-carboxamide ;

du (-)-(R)-4-amino-5-chloro-2,3-dihydro-N-[1-[(tétrahydro-2-furanyl)méthyl]-4-pipéridinyl]-7-benzofuranecarboxamide ; et

du 4-amino-5-chloro-N-[1-(3-cyanopropyl)-4-pipéridinyl]-2,3-dihydro-2,2-diméthyl-7-benzofuranecarboxamide.

5. Procédé de préparation d'un composé de formule



forme N-oxyde, sel ou forme stéréochimiquement isomère de celui-ci, où :

A est un radical de formules

-CH₂-CH₂- (a-1),

-CH₂-CH₂-CH₂- (a-2), ou

-CH₂-CH₂-CH₂-CH₂- (a-3),

dans lesquelles un ou deux atomes d'hydrogène dans lesdits radicaux (a-1) à (a-3) peuvent être remplacés par un radical alkyle en C₁₋₆ ;

R¹ est un hydrogène ou un halogéno ;

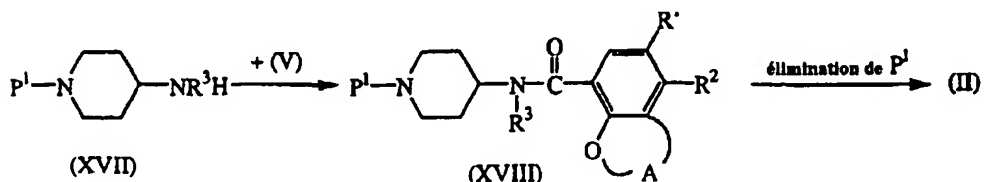
R² est un hydrogène, un amino, un mono- ou di(C₁₋₆-alkyl)amino ou un C₁₋₆-alkylcarbonylamino ; et

R³ est un hydrogène ou un alkyle en C₁₋₆ ;

caractérisé par

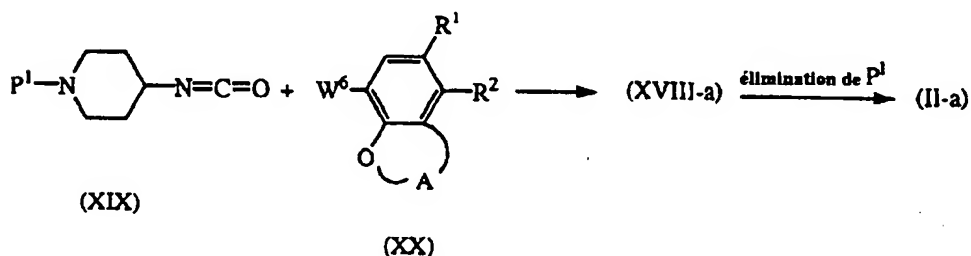
a) la réaction d'une pipéridine de formule (XVII) substituée de manière appropriée, dans laquelle R³ est un hydrogène ou un alkyle en C₁₋₆ et P¹ représente un groupe protecteur approprié qui peut être aisément éliminé par hydrogénation ou hydrolyse, comme par exemple un phénylméthyle, ou un groupe hydrolysable, tel qu'un C₁₋₄-alkyloxycarbonyl, par exemple un éthoxycarbonyl, un benzyloxycarbonyl, avec un réactif de formule (V) ou un dérivé fonctionnel de celui-ci, et l'élimination ultérieure du groupe protecteur

P¹ dans l'intermédiaire (XVII) ainsi obtenu, en suivant des modes opératoires connus dans l'art, par exemple par hydrolyse dans un milieu acide ou alcalin ou par hydrogénation catalytique, en fonction de la nature de P¹ ;



15 b) la réaction d'un isocyanate de formule (XIX) avec un intermédiaire de formule (XX), dans laquelle W⁵ est un métal alcalin, par exemple le lithium, le sodium et similaires ; ou un halogénure de magnésium, par exemple le bromure de magnésium ou le chlorure de magnésium, en donnant lieu à un intermédiaire de

20 formule (XVIII-a), dans laquelle R³ est H, ledit intermédiaire étant représenté par la formule (XVIII-a) ; et la déprotection telle que décrite ci-dessus, pour donner lieu aux intermédiaires de formule (II-a), dans laquelle R³ est un hydrogène



35 ou éventuellement la transformation des composés de formule (I) les uns en les autres en suivant des modes opératoires de transformation de groupes fonctionnels connus dans l'art, et, si on le souhaite, la transformation d'un composé de formule (I) en un sel thérapeutiquement actif et non toxique par traitement avec un acide approprié, ou inversement, la transformation de la forme de sel en forme basique libre avec un alcali ; et/ou la préparation de formes N-oxyde et de formes stéréochimiquement isomères de celui-ci.

- 40 6. Procédé de préparation d'une composition pharmaceutique comprenant un support inerte et, en tant qu'ingrédient actif, une quantité d'un composé de formule (I), stimulant la motilité gastro-intestinale ; caractérisé en ce qu'une quantité thérapeutiquement efficace d'un composé de formule (I) est mélangée intimement avec un support pharmaceutique.